Technical Information
iTHERM TM411

Trend-setting, modular resistance thermometer for hygienic and aseptic applications



Easy-to-use metric version with outstanding sensor technology

Applications

- Specially designed for use in hygienic and aseptic applications in the Food & Beverages and Life Sciences industries
- Measuring range: –200 to +600 °C (–328 to +1 112 °F)
- Pressure range up to 50 bar (725 psi)
- Protection class: up to IP69K

Head transmitter

All Endress+Hauser transmitters are available with enhanced accuracy and reliability compared to directly wired sensors. Easy customizing by choosing one of the following outputs and communication protocols:

- Analog output 4 to 20 mA, HART®
- PROFIBUS® PA, FOUNDATION Fieldbus™

Your benefits

- User-friendly and reliable from product selection to maintenance
- iTHERM inserts: globally unique, automated production. Full traceability and consistently high product quality for reliable measured values
- iTHERM QuickSens: fastest response times (t_{90s}: 1.5 s) for optimum process control
- iTHERM StrongSens: unsurpassed vibration resistance (> 60g) for ultimate plant safety
- iTHERM QuickNeck – cost and time savings thanks to simple, tool-free recalibration
- iTHERM TA30R: 316L terminal head for easier handling and lower installation and maintenance costs, and with highest IP69K rating
- International certification: explosion protection e.g. ATEX/IECEx and in compliance with hygiene standards according to 3-A®, EHEDG, ASME BPE, FDA, TSE Certificate of Suitability

Endress+Hauser
People for Process Automation

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Function and system design

iTHERM Hygiene line

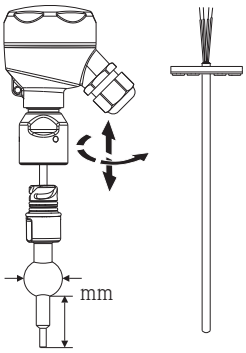
This thermometer is part of the product line of modular thermometers for hygienic and aseptic applications.

Differentiating factors when selecting a suitable thermometer

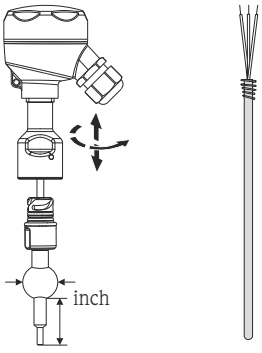
TM4x**1**	TM4x**2**
Metric version	Imperial version

TMx**1**x characterizes the device that uses cutting-edge technology, with features such as a replaceable insert, quick-fastening extension neck (iTHERM QuickNeck), vibration-resistant and fast-response sensor technology (iTHERM StrongSens and QuickSens) and approval for use in hazardous areas

TM411

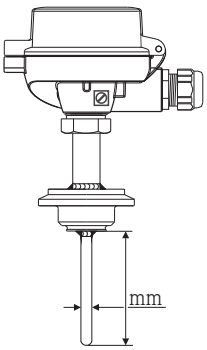


TM412

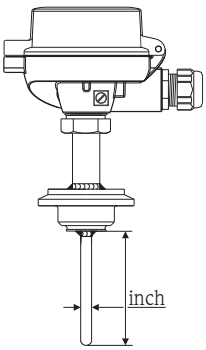


TMx**0**x characterizes the device that uses basic technology, with features such as a fixed, non-replaceable insert, application in non-hazardous areas, standard extension neck, low-cost unit

TM401



TM402



Measuring principle

Resistance thermometer (RTD)

These resistance thermometers use a Pt100 temperature sensor according to IEC 60751. The temperature sensor is a temperature-sensitive platinum resistor with a resistance of 100 Ω at 0 °C (32 °F) and a temperature coefficient α = 0.003851 $°C^{-1}$.

There are generally two different kinds of platinum resistance thermometers:

- **Wire wound (WW):** Here, a double coil of fine, high-purity platinum wire is located in a ceramic support. This is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate very reproducible measurements but also offer good long-term stability of the resistance/temperature characteristic within temperature ranges up to 600 °C (1 112 °F). This type of sensor is relatively large in size and it is comparatively sensitive to vibrations.
- **Thin film platinum resistance thermometers (TF):** A very thin, ultrapure platinum layer, approx. 1 µm thick, is vaporized in a vacuum on a ceramic substrate and then structured photolithographically. The platinum conductor paths formed in this way create the measuring resistance. Additional covering and passivation layers are applied and reliably protect the thin platinum layer from contamination and oxidation, even at high temperatures.

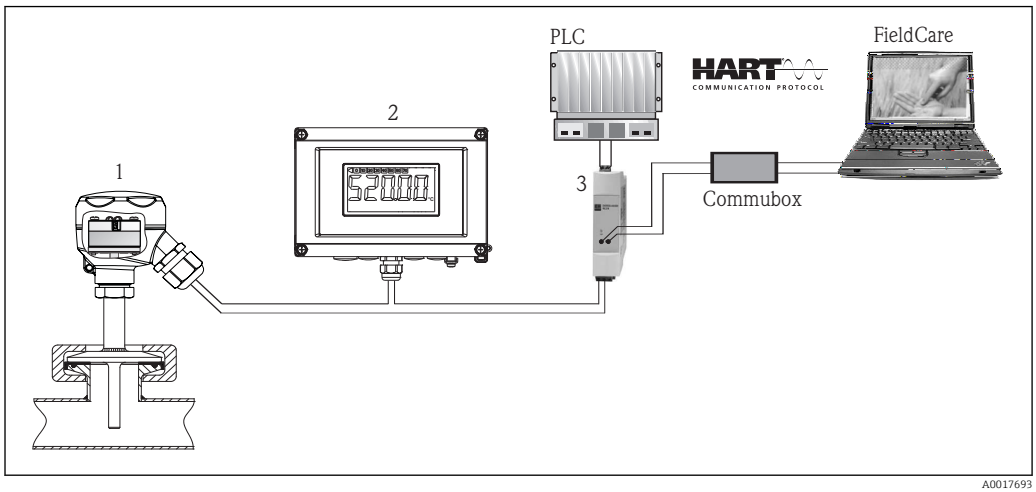
The primary advantages of thin film temperature sensors over wire wound versions are their smaller sizes and better vibration resistance. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among TF sensors at high temperatures. As a result, the tight limit values of tolerance category A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 °C (572 °F). For this reason, thin-film sensors are generally only used for temperature measurements in ranges below 400 °C (752 °F).

Measuring system

Endress+Hauser offers a complete portfolio of optimized components for the temperature measuring point – everything you need for the seamless integration of the measuring point into the overall facility. This includes:

- Power supply unit/barrier
- Display units
- Overvoltage protection

For more information, see the brochure 'System Components - Solutions for a Complete Measuring Point' (FA00016K/EN)



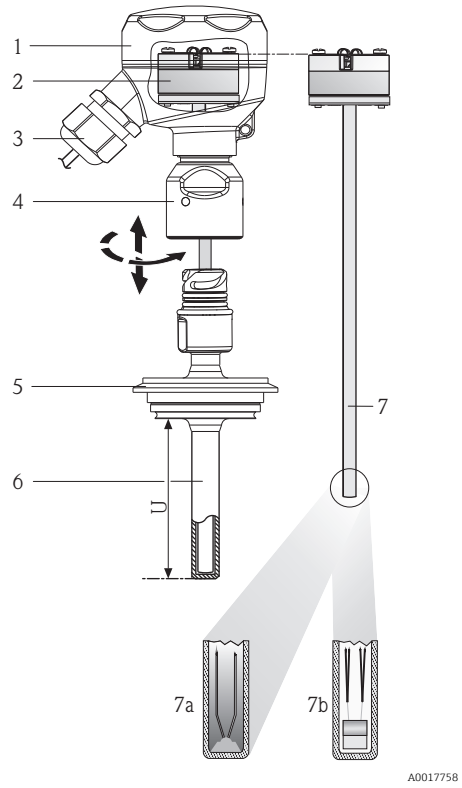
1 Example of application, measuring point layout with additional Endress+Hauser components

1 Installed iTHERM resistance thermometer with integrated HART® head transmitter

2 RIA16 field display unit - The display unit records the analog measuring signal from the head transmitter and shows this on the display. The LC display shows the current measured value in digital form and as a bar graph indicating a limit value violation. The display unit is looped into the 4 to 20 mA circuit and gets the required energy from there. More information on this can be found in the Technical Information, see "Documentation", (→ 48).

3 Active barrier RN221N - The RN221N (24 V DC, 30 mA) active barrier has a galvanically isolated output for supplying voltage to loop-powered transmitters. The universal power supply works with an input supply voltage of 20 to 250 V DC/AC, 50/60 Hz, which means that it can be used in all international power grids. More information on this can be found in the Technical Information, see "Documentation", (→ 48).

Modular design

Design		Options
	1: Terminal head (→ 🖹 31)	▪ 316L, low head, optionally with display window ▪ Aluminum, high or low head, with or without display window ▪ Polypropylene, low head ▪ Polyamide, high head, without display window **Your benefits:** ▪ Optimum terminal access thanks to low housing edge of bottom section: – Easier to use – Lower installation and maintenance costs ▪ Optional display: local process display unit for added reliability ▪ IP69K protection: optimum protection even with high-pressure cleaning
	2: Wiring, electrical connection, output signal (→ 🖹 6)	▪ Ceramic terminal block ▪ Flying leads ▪ Head transmitter (4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus), single-channel or two-channel ▪ Attachable display (optional)
	3: Connector or cable gland (→ 🖹 33)	▪ PROFIBUS® PA / FOUNDATION™ Fieldbus connector, 4-pin ▪ 8-pin connector ▪ Polyamide or brass cable glands
	4: Extension neck (→ 🖹 33)	Welded-in-place or removable either with the quick fastener (iTHERM QuickNeck) or thread adapter nut G3/8" **Your benefits:** ▪ **iTHERM QuickNeck:** tool-free removal of the insert: – Saves time/costs on frequently calibrated measuring points – Wiring mistakes avoided ▪ IP69K protection: safety under extreme process conditions
	5: Process connection (→ 🖹 35)	More than 50 different versions.
	6: Thermowell (→ 🖹 35)	▪ Versions with and without thermowell (insert in direct contact with process). ▪ Various diameters ▪ Various tip shapes (straight or reduced)
	7: Insert (→ 🖹 30) with: 7a: iTHERM QuickSens 7b: iTHERM StrongSens	Sensor models: wire wound (WW) or thin-film sensor (TF). **Your benefits:** ▪ **iTHERM QuickSens** - insert with the world's fastest response time: – Insert: ⌀3 mm (⅛ in) or ⌀6 mm (¼ in) – Fast, highly accurate measurements, delivering maximum process safety and control – Quality and cost optimization – Minimization of necessary immersion length: better product protection thanks to improved process flow ▪ **iTHERM StrongSens** - insert with unbeatable durability: – Vibration resistance > 60g: lower life cycle costs thanks to longer operating life and high plant availability – Automated, traceable production: top quality and maximum process safety – High long-term stability: reliable measured values and high level of system safety

Input

Measured variable

Temperature (temperature-linear transmission behavior)

Measuring range

Depends on the type of sensor used

Sensor type	Measuring range
Pt100 thin-film	−50 to +400 °C (−58 to +752 °F)
Pt100 thin-film, iTHERM StrongSens, vibration-resistant > 60g	−50 to +500 °C (−58 to +932 °F)
Pt100 thin-film, iTHERM QuickSens, fast-response	−50 to +200 °C (−58 to +392 °F)
Pt100 wire wound, extended measuring range	−200 to +600 °C (−328 to +1 112 °F)

Output

Output signal

Generally, the measured value can be transmitted in one of two ways:

- Directly-wired sensors - sensor measured values forwarded without a transmitter.
- Via all common protocols by selecting an appropriate Endress+Hauser iTEMP temperature transmitter. All the transmitters listed below are mounted directly in the terminal head and wired with the sensory mechanism.

Family of temperature transmitters

Thermometers fitted with iTEMP transmitters are an installation-ready complete solution to improve temperature measurement by significantly increasing accuracy and reliability, when compared to direct wired sensors, as well as reducing both wiring and maintenance costs.

PC programmable head transmitters
They offer a high degree of flexibility, thereby supporting universal application with low inventory storage. The iTEMP transmitters can be configured quickly and easily at a PC. Endress+Hauser offers free configuration software which can be downloaded from the Endress+Hauser Website. More information can be found in the Technical Information.

HART® programmable head transmitters
The transmitter is a 2-wire device with one or two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART® communication. It can be installed as an intrinsically safe apparatus in Zone 1 hazardous areas and is used for instrumentation in the terminal head (flat face) as per DIN EN 50446. Swift and easy operation, visualization and maintenance by PC using operating software, Simatic PDM or AMS. For more information, see the Technical Information.

PROFIBUS® PA head transmitters
Universally programmable head transmitter with PROFIBUS® PA communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. Swift and easy operation, visualization and maintenance using a PC directly from the control panel, e. g. using operating software, Simatic PDM or AMS. For more information, see the Technical Information.

FOUNDATION Fieldbus™ head transmitters
Universally programmable head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. Swift and easy operation, visualization and maintenance using a PC directly from the control panel, e.g. using operating software such as ControlCare from Endress +Hauser or NI Configurator from National Instruments. For more information, see the Technical Information.

Advantages of the iTEMP transmitters:
- Dual or single sensor input (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic functions
- Sensor-transmitter matching for dual sensor input transmitter, based on Callendar/Van Dusen coefficients

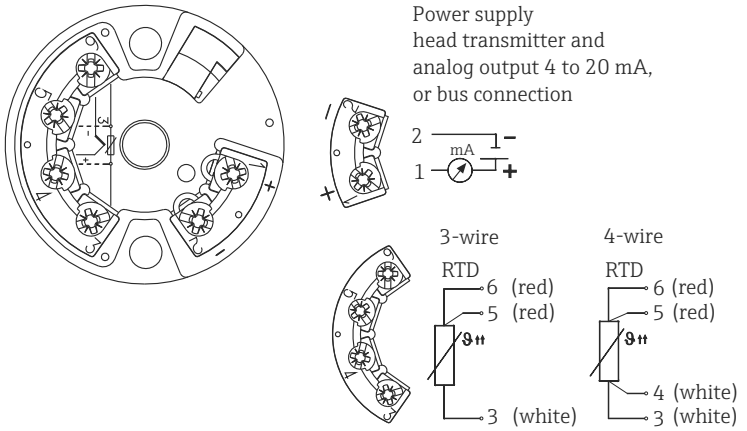
Wiring

- According to the 3-A® Standard electrical connecting cables must be smooth, corrosion-resistant and easy to clean.
- Grounding or shield connections are possible via special ground terminals on the terminal head. (→ 🖹 31)

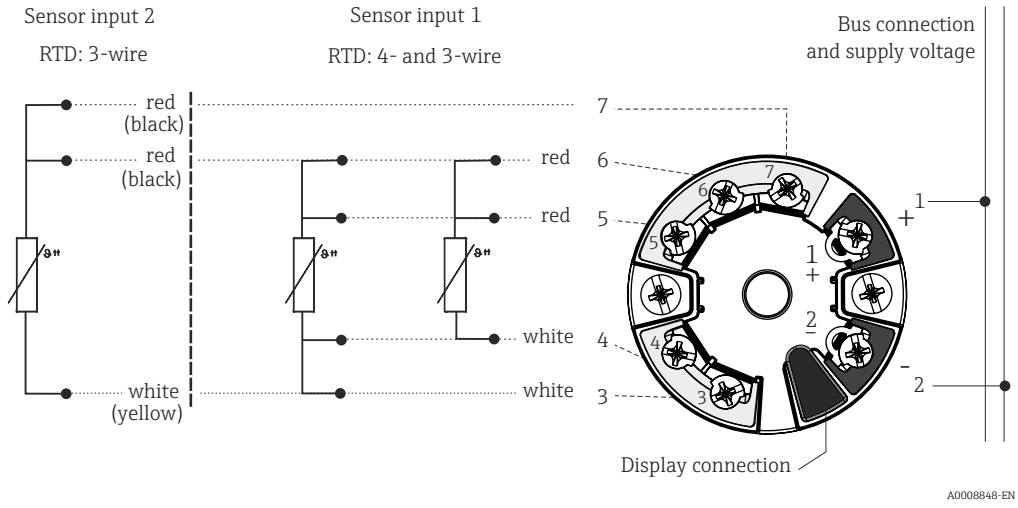
Wiring diagrams for RTD

Type of sensor connection

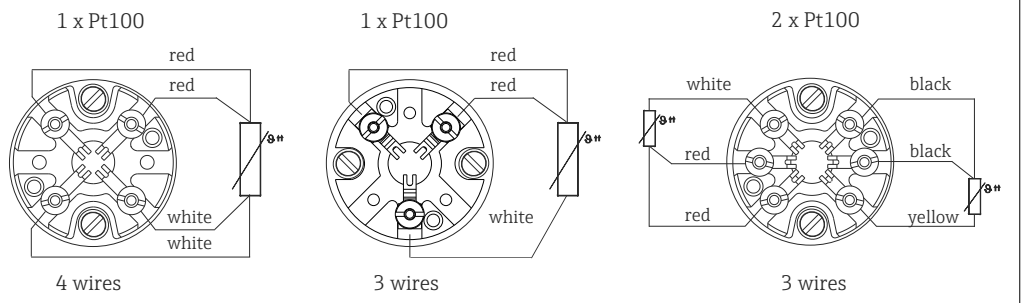
Head mounted transmitter TMT18x (single input)



Head mounted transmitter TMT8x (dual input)



Terminal block mounted



Cable entries

See 'Terminal heads' section (→ 31)

Connectors

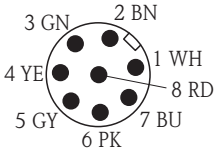
Endress+Hauser offers a wide variety of connectors for the simple and fast integration of the thermometer into a process control system. The following tables show the PIN assignments of the various plug connector combinations.

Abbreviations

#1	Order: first transmitter/insert	#2	Order: second transmitter/insert
i	Insulated. Wires marked 'i' are not connected and are insulated with heat shrink tubes.	YE	Yellow
GND	Grounded. Wires marked 'GND' are connected to the internal grounding screw in the terminal head.	RD	Red
BN	Brown	WH	White
GNYE	Green-yellow	PK	Pink
BU	Blue	GN	Green
GY	Gray	BK	Black

Terminal head with one cable entry

Plug	**1x PROFIBUS PA**								**1x FOUNDATION™ Fieldbus (FF)**				**8-pin**							
Plug thread	M12				7/8"				7/8"				M12							
PIN number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8
Electrical connection (terminal head)																				
Flying leads	Not connected (not insulated)																			
3-wire terminal block (1x Pt100)	RD	RD	WH		RD	RD	WH		RD	RD	WH		RD	RD	WH		i			
4-wire terminal block (1x Pt100)			WH	WH			WH	WH			WH	WH			WH	WH				
6-wire terminal block (2x Pt100)	RD (#1) 1)	RD (#1)	WH (#1)		RD (#1)	RD (#1)	WH (#1)		RD (#1)	RD (#1)	WH (#1)				WH		BK	BK	YE	
1x TMT 4 to 20 mA or HART®	+	i	-	i	+	i	-	i	+	i	-	i	+ (#1)	i	- (#1)	i	i			
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover	+ (#1)	+ (#2)	- (#1)	- (#2)	+ (#1)	+ (#2)	- (#1)	- (#2)	+ (#1)	+ (#2)	- (#1)	- (#2)					+ (#2)	i	- (#2)	i
1x TMT PROFIBUS® PA	+	i	-	GND 2)	+	i	-	GND	Cannot be combined				Cannot be combined							

Plug	1x PROFIBUS PA								1x FOUNDATION™ Fieldbus (FF)				8-pin
2x TMT PROFIBUS® PA	+ (#1)		- (#1)		+		-						
1x TMT FF	Cannot be combined				Cannot be combined				-	+	GND	i	Cannot be combined
2x TMT FF									- (#1)	+ (#1)			
PIN position and color code	 1 BN 2 GNYE 3 BU 4 GY A0018929				 1 BN 2 GNYE 3 BU 4 GY A0018930				 1 BU 2 BN 3 GY 4 GNYE A0018931				 A0018927

1) Second Pt100 is not connected
2) If a plastic housing TA30S or TA30P is used, insulated 'i' instead of grounded GND

Terminal head with two cable entries

Plug	2x PROFIBUS® PA								2x FOUNDATION™ Fieldbus (FF)			
Plug thread  A0021706	M12(#1) / M12(#2)				7/8"(#1) / 7/8"(#2)				7/8"(#1) / 7/8"(#2)			
PIN number	1	2	3	4	1	2	3	4	1	2	3	4
Electrical connection (terminal head)												
Flying leads	Not connected (not insulated)											
3-wire terminal block (1x Pt100)	RD/i	RD/i	WH/i		RD/i	RD/i	WH/i		RD/i	RD/i	WH/i	
4-wire terminal block (1x Pt100)			WH/i	WH/i			WH/i	WH/i			WH/i	WH/i
6-wire terminal block (2x Pt100)	RD/BK	RD/BK	WH/YE		RD/BK	RD/BK	WH/YE		RD/BK	RD/BK	WH/YE	
1x TMT 4 to 20 mA or HART®	+/i	i/i	-/i	i/i	+/i	i/i	-/i	i/i	+/i	i/i	-/i	i/i
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover	+(#1)/ +(#2)		-(#1)/ -(#2)		+(#1)/ +(#2)		-(#1)/ -(#2)		+(#1)/ +(#2)		-(#1)/ -(#2)	
1x TMT PROFIBUS® PA	+/i		-/i	GND/ GND	+/i		-/i	GND/ GND	Cannot be combined			
2x TMT PROFIBUS® PA	+(#1)/ +(#2)		-(#1)/ -(#2)		+(#1)/ +(#2)		-(#1)/ -(#2)					
1x TMT FF	Cannot be combined				Cannot be combined				-/i	+/i	i/i	GND/GND
2x TMT FF									-(#1)/ -(#2)	+(#1)/ +(#2)		
PIN position and color code	 1 BN 2 GNYE 3 BU 4 GY A0018929				 1 BN 2 GNYE 3 BU 4 GY A0018930				 1 BU 2 BN 3 GY 4 GNYE A0018931			

Connection combination: insert - transmitter

Insert	Transmitter connection [1]			
	1x 1-channel	2x 1-channel	1x 2-channel	2x 2-channel
1x Pt100, flying leads	Pt100 (#1) : transmitter (#1)	Pt100 (#1) : transmitter (#1) (Transmitter (#2) not connected)	Pt100 (#1) : transmitter (#1)	Pt100 (#1) : transmitter (#1) Transmitter (#2) not connected
2x Pt100, flying leads	Pt100 (#1) : transmitter (#1) Pt100 (#2) insulated	Pt100 (#1) : transmitter (#1) Pt100 (#2): transmitter (#2)	Pt100 (#1) : transmitter (#1) Pt100 (#2) : transmitter (#1)	Pt100 (#1) : transmitter (#1) Pt100 (#2) : transmitter (#1) (Transmitter (#2) not connected)
1x Pt100 with terminal block [2]	Pt100 (#1) : transmitter in cover	Cannot be combined	Pt100 (#1) : transmitter in cover	Cannot be combined
2x Pt100 with terminal block	Pt100 (#1) : transmitter in cover Pt100 (#2) not connected		Pt100 (#1) : transmitter in cover Pt100 (#2) : transmitter in cover	

1) If 2 transmitters are selected in a terminal head, transmitter (#1) is installed directly on the insert. Transmitter (#2) is installed in the high cover. A TAG cannot be ordered for the 2nd transmitter as standard. The bus address is set to the default value and, if necessary, must be changed manually before commissioning.
2) Only in the terminal head with a high cover, only 1 transmitter possible.

Overvoltage protection

To protect against overvoltage in the power supply and signal/communication cables for the thermometer electronics, Endress+Hauser offers the HAW562 surge arrester for DIN rail mounting and the HAW569 for field housing installation.

For more information see the Technical Information 'HAW562 Surge arrester' TI01012K and 'HAW569 Surge arrester' TI01013K.

Performance characteristics

Reference conditions

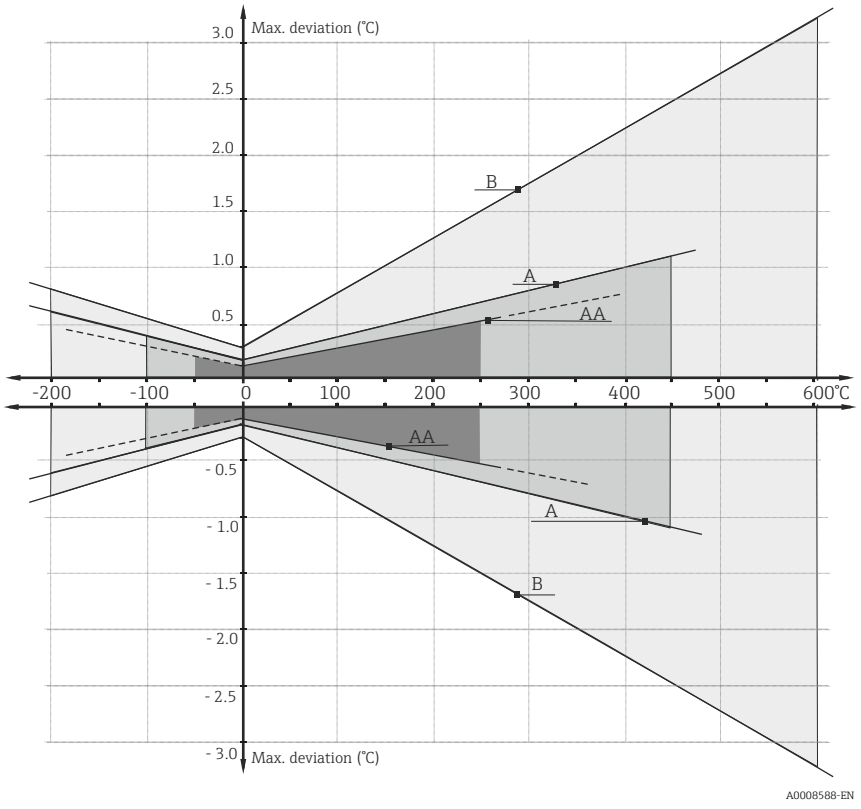
These data are relevant for determining the accuracy of the temperature transmitters used. More information on this can be found in the Technical Information of the iTEMP temperature transmitters. (→ 48)

Accuracy

RTD resistance thermometer as per IEC 60751

Class	Max. tolerances (°C)	
Cl. AA, former 1/3 Cl. B	± (0.1 + 0.0017 · |t| [1])	
Cl. A	± (0.15 + 0.002 · |t|)	
Cl. B	± (0.3 + 0.005 · |t|)	
Temperature ranges for compliance with the tolerance classes		
Wire wound sensor (WW):	Cl. A	Cl. AA
	−100 to +450 °C	−50 to +250 °C
Thin-film version (TF):	Cl. A	Cl. AA
▪ Standard	−30 to +300 °C	0 to +150 °C
▪ iTHERM QuickSens	−30 to +200 °C	0 to +200 °C
▪ iTHERM StrongSens	−30 to +300 °C	0 to +200 °C

Characteristics



1) |t| = absolute value °C

In order to obtain the maximum tolerances in °F, the results in °C must be multiplied by a factor of 1.8.

Influence of ambient temperature

Depends on the head transmitter used. For details, see Technical Information. (→ 🖹 48)

Self heating

RTD elements are passive resistances that are measured using an external current. This measurement current causes a self-heating effect in the RTD element itself which in turn creates an additional measurement error. In addition to the measurement current, the size of the measurement error is also affected by the temperature conductivity and flow velocity of the process. This self-heating error is negligible when an Endress+Hauser iTEMP temperature transmitter (very small measurement current) is connected.

Response time

Tests in water at 0.4 m/s (1.3 ft/s), according to IEC 60751; 10 K temperature step change.

Response time with heat transfer paste [1]

Protection tube	Shape of tip	Insert	1x Pt100 iTHERM QuickSens, TF		1x Pt100 iTHERM StrongSens, TF		1x Pt100 wire wound WW		2x Pt100 wire wound WW		1x Pt100 standard thin-film TF	
			t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}
Without protection tube	-	Φ6 mm (¼ in)	0.5 s	1.5 s	2.5 s	9.5 s	4 s	11.5 s	4.5 s	12 s	4.75 s	13 s
Φ6 mm (¼ in)	Reduced 4.3 mm (0.17 in) x 20 mm (0.79 in)	Φ3 mm (⅛ in)	1 s	2.5 s	-		8.5 s	26 s	5.5 s	18 s	8 s	23 s
Φ9 mm (0.35 in)	Straight	Φ6 mm (¼ in)	2 s	9 s	8 s	27 s	15 s	45 s	15 s	45 s	9.5 s	27 s

Protection tube	Shape of tip	Insert	1x Pt100 iTHERM QuickSens, TF		1x Pt100 iTHERM StrongSens, TF		1x Pt100 wire wound WW		2x Pt100 wire wound WW		1x Pt100 standard thin-film TF	
			t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}
	Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)	Φ3 mm (⅛ in)	1.25 s	4 s	-		7 s	20 s	7 s	20 s	7 s	23 s
	Tapered 6.6 mm (0.26 in) x 60 mm (2.36 in)	Φ3 mm (⅛ in)	2.5 s	12 s	-		14 s	49 s	12 s	40 s	15 s	51 s
Φ12.7 mm (½ in)	Straight	Φ6 mm (¼ in)	4 s	26 s	12 s	54 s	23 s	81 s	23 s	81 s	31 s	100 s
	Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)	Φ3 mm (⅛ in)	1.5 s	5.5 s	-		9 s	27 s	9 s	27 s	6.5 s	21 s
	Reduced 8 mm (0.31 in) x 32 mm (1.26 in)	Φ6 mm (¼ in)	6 s	36 s	11 s	44 s	22 s	69 s	22 s	69 s	26 s	90 s

1) If using a protection tube.

Response time without heat transfer paste [1)]

Protection tube	Shape of tip	Insert	1x Pt100 iTHERM QuickSens, TF		1x Pt100 iTHERM StrongSens, TF		1x Pt100 wire wound WW		2x Pt100 wire wound WW		1x Pt100 standard thin-film TF	
			t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}
Without protection tube	-	Φ3 mm (⅛ in)	0.5 s	0.75 s	-		1.75 s	5 s	2 s	6 s	2.5 s	5.5 s
		Φ6 mm (¼ in)		1.5 s	2.5 s	9.5 s	4 s	11.5 s	4.5 s	12 s	4.75 s	13 s
Φ6 mm (¼ in)	Reduced 4.3 mm (0.17 in) x 20 mm (0.79 in)	Φ3 mm (⅛ in)	1 s	3 s	-		9 s	27 s	7.5 s	24 s	8.5 s	28 s
Φ9 mm (0.35 in)	Straight	Φ6 mm (¼ in)	2 s	9 s	8 s	29 s	19 s	62 s	19 s	62 s	13.5 s	42 s
	Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)	Φ3 mm (⅛ in)	1.5 s	5 s	-		7 s	21 s	7 s	21 s	8 s	22 s
	Tapered 6.6 mm (0.26 in) x 60 mm (2.36 in)	Φ3 mm (⅛ in)	5 s	23 s	-		13 s	45 s	13 s	45 s	15.5 s	60 s
Φ12.7 mm (½ in)	Straight	Φ6 mm (¼ in)	5.5 s	41 s	12 s	54 s	23 s	82 s	23 s	82 s	32 s	105 s
	Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)	Φ3 mm (⅛ in)	2 s	6 s	-		10 s	30 s	10 s	30 s	8 s	30 s
	Reduced 8 mm (0.31 in) x 32 mm (1.26 in)	Φ6 mm (¼ in)	14.5 s	65 s	16 s	53 s	26 s	85 s	26 s	85 s	32 s	108 s

1) If using a protection tube.

Response time for directly wired insert without transmitter.

Calibration

Calibration of thermometers

Calibration involves comparing the measured values of a device under test (DUT) with those of a more precise calibration standard using a defined and reproducible measurement method. The aim is to determine the deviation of the DUT's measured values from the true value of the measured variable. Two different methods are used for thermometers:

- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C,
- Calibration compared against a precise reference thermometer.

The thermometer to be calibrated must display the fixed point temperature or the temperature of the reference thermometer as accurately as possible. Temperature-controlled calibration baths with very homogeneous thermal values, or special calibration furnaces into which the DUT and the reference thermometer, where necessary, can project to a sufficient degree, are typically used for thermometer calibrations.

Evaluation of thermometers

If a calibration with an acceptable uncertainty of measurement and transferable measurement results is not possible, Endress+Hauser offers customers a thermometer evaluation measurement service, if technically feasible. This is the case when:

- The process connections/flanges are too big or the immersion length (IL) is too short to allow the DUT to be immersed sufficiently in the calibration bath or furnace (see the following table), or
- Due to heat conduction along the thermometer tube, the resulting sensor temperature generally deviates significantly from the actual bath/furnace temperature.

The measured value of the DUT is determined using the maximum possible immersion depth and the specific measuring conditions and measurement results are documented on an evaluation certificate.

Sensor transmitter matching

The resistance/temperature curve of platinum resistance thermometers is standardized but in practice it is rarely possible to keep to the values precisely over the entire operating temperature range. For this reason, platinum resistance sensors are divided into tolerance classes, such as Class A, AA or B as per IEC 60751. These tolerance classes describe the maximum permissible deviation of the specific sensor characteristic curve from the standard curve, i.e. the maximum temperature-dependent characteristic error that is permitted. The conversion of measured sensor resistance values to temperatures in temperature transmitters or other meter electronics is often susceptible to considerable errors as the conversion is generally based on the standard characteristic curve.

When using E+H temperature transmitters, this conversion error can be reduced significantly by sensor-transmitter matching:

- Calibration at three temperatures at least and determination of the actual temperature sensor characteristic curve,
- Adjustment of the sensor-specific polynomial function using Calendar-van Dusen (CvD) coefficients,
- Configuration of the temperature transmitter with the sensor-specific CvD coefficients for resistance/temperature conversion, and
- another calibration of the reconfigured temperature transmitter with connected resistance thermometer.

Endress+Hauser offers its customers this kind of sensor-transmitter matching as a separate service. Furthermore, the sensor-specific polynomial coefficients of platinum resistance thermometers are always provided on every Endress + Hauser calibration certificate where possible, e.g. at least three calibration points, so that users themselves can also appropriately configure suitable temperature transmitters.

For the device, Endress+Hauser offers standard calibrations at a reference temperature of −80 to +600 °C (−112 to +1 112 °F) based on the ITS90 (International Temperature Scale). Calibrations in other temperature ranges are available from your Endress+Hauser sales center on request. Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the device. Only the insert is calibrated.

Minimum insertion length (IL) for inserts required to perform a correct calibration

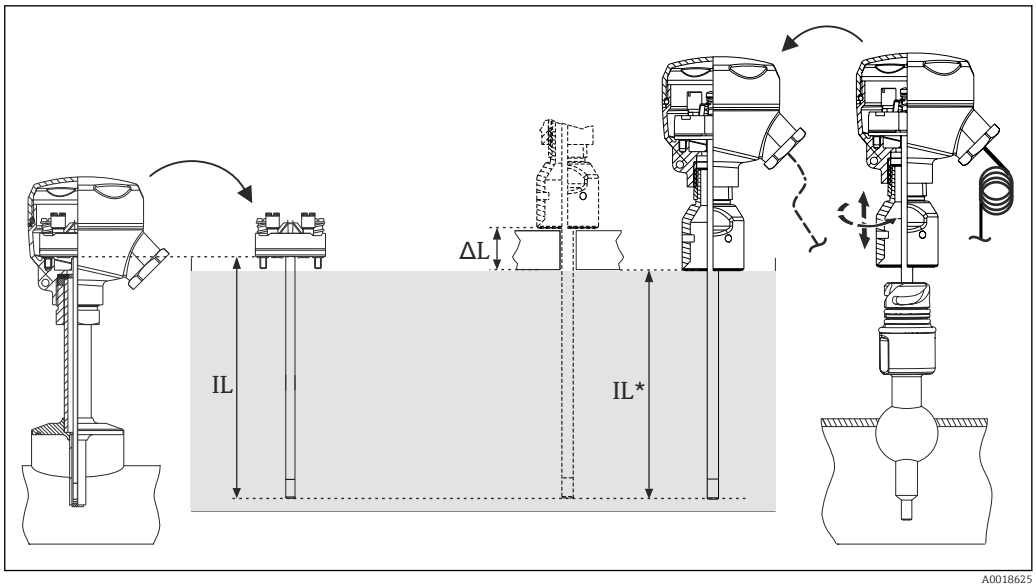
The insert length IL is automatically calculated for every thermometer configuration in the Endress+Hauser Konfigurator[+Temperature] software application. The system also automatically checks whether the selected insert length suffices to perform a factory calibration. For further information, see the 'Accessories' section (→ 47).

Minimum insertion length (IL) - insert: Φ3 mm

Sensor type	iTHERM QuickSens		Standard thin-film		Wire wound	
Measuring range	−50 to +200 °C (−58 to +392 °F)		−50 to +400 °C (−58 to +752 °F)		−200 to +600 °C (−328 to +1 112 °F)	
Calibration temperature	with head transmitter	without head transmitter	with head transmitter	without head transmitter	with head transmitter	without head transmitter
−196 °C (−320.8 °F)	-		-		140 mm (5.51 in)	110 mm (4.33 in)
−80 to −41 °C (−112.0 to −41.8 °F)	-		130 mm (5.11 in)	110 mm (4.33 in)	130 mm (5.11 in)	110 mm (4.33 in)
−40 to −1 °C (−40.0 to +30.2 °F)	35 mm (1.38 in)					
0 to +150 °C (+32.0 to +302.0 °F)	65 mm (2.56 in)	35 mm (1.38 in)	100 mm (3.94 in)	80 mm (3.15 in)	100 mm (3.94 in)	80 mm (3.15 in)
+151 to +250 °C (+303.8 to +482.0 °F)			140 mm (5.51 in)	110 mm (4.33 in)	140 mm (5.51 in)	110 mm (4.33 in)
+251 to +550 °C (+483.8 to +1 022.0 °F)	-		300 mm (11.81 in)			
+551 to +600 °C (+1 023.8 to +1 112.0 °F)	-				400 mm (15.75 in)	

Minimum insertion length (IL) - insert: Φ6 mm

Sensor type	iTHERM QuickSens		iTHERM StrongSens		Standard thin-film		Wire wound	
Measuring range	−50 to +200 °C (−58 to +392 °F)		−50 to +500 °C (−58 to +932 °F)		−50 to +400 °C (−58 to +752 °F)		−200 to +600 °C (−328 to +1 112 °F)	
Calibration temperature	with head transmitter	without head transmitter	with head transmitter	without head transmitter	with head transmitter	without head transmitter	with head transmitter	without head transmitter
−196 °C (−320.8 °F)	-						150 mm (5.91 in)	120 mm (4.72 in)
−80 to −41 °C (−112.0 to −41.8 °F)	-				150 mm (5.91 in)	120 mm (4.72 in)	140 mm (5.51 in)	
−40 to −1 °C (−40.0 to +30.2 °F)	40 mm (1.57 in)		70 mm (2.76 in)					
0 to +150 °C (+32.0 to +302.0 °F)	70 mm (2.76 in)	40 mm (1.57 in)	100 mm (3.94 in)	70 mm (2.76 in)	140 mm (5.51 in)			
+151 to +250 °C (+303.8 to +482.0 °F)					150 mm (5.91 in)		150 mm (5.91 in)	
+251 to +550 °C (+483.8 to +1 022.0 °F)	-		300 mm (11.81 in)					
+551 to +600 °C (+1 023.8 to +1 112.0 °F)	-						400 mm (15.75 in)	



2 *Minimum insertion lengths for sensor calibration*

IL Minimum insertion length for factory calibration or recalibration onsite without the iTHERM QuickNeck extension neck
IL Minimum insertion length for recalibration onsite with the iTHERM QuickNeck extension neck*
ΔL Additional length, depending on the calibration unit, if the insert cannot be fully immersed

- To check the actual accuracy rating of the thermometers installed, a cyclic calibration of the installed sensor is frequently performed. The insert is normally removed for comparison with a precise reference thermometer in the calibration bath (see graphic, left part). A reproducible calibration requires the insert to have a minimum insertion length IL. If the insert is shorter than this minimum length, this reproducibility cannot be guaranteed.
- The iTHERM QuickNeck enables the quick, tool-free removal of the insert for calibration purposes. The entire upper part of the thermometer is released by turning the terminal head. The insert is removed from the protection tube and directly immersed into the calibration bath (see graphic, right part). Make sure that the cable is long enough to be able to reach the mobile calibration bath with the cable connected. If this is not possible for the calibration, it is advisable to use a connector. (→ 33)

Advantages of iTHERM QuickNeck:
- Considerable time savings when recalibrating the device (up to 20 minutes per measuring point)
- Wiring mistakes avoided when re-installing
- Minimum plant downtime, thereby saving costs

The minimum immersion length is the length of the insert that is fully immersed in the calibration bath. For a valid recalibration, the value selected for the length IL* must be at least the value of the previously defined minimum insertion lengths (IL) of the specific types of insert. For more detailed values, see the previous tables, values without head transmitter.
If the calibration unit used does not allow the insert to be fully immersed as far as the bottom edge of the top part of the iTHERM QuickNeck, it might be necessary to add an additional length (ΔL) to IL*. (→ 2, 15)

Formulas for calculating the IL when recalibrating onsite with iTHERM QuickNeck*

Version, with M24x1.5 or NPT ½" thread to terminal head	Formula
Protection tube diameter 6 mm (¼ in)	IL* = U + T + 5 mm (0.2 in)
Protection tube diameter 9 mm (0.35 in)	IL* = U + T - 25 mm (0.98 in)
Protection tube diameter 12.7 mm (½ in)	IL* = U + T + 5 mm (0.2 in)

Insulation resistance

Insulation resistance ≥ 100 MΩ at ambient temperature.

Insulation resistance between the terminals and the outer jacket is measured with a minimum voltage of 100 V DC.

Installation

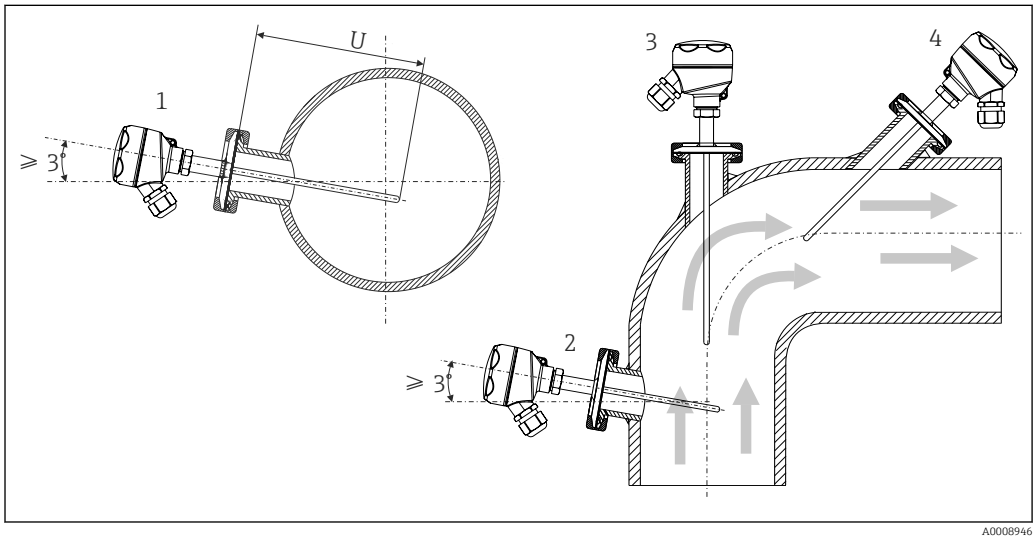
Orientation

No restrictions. However, self-draining in the process must be guaranteed. If there is an opening to detect leaks at the process connection, this opening must be at the lowest possible point.

Installation instructions

The immersion length of the thermometer can influence the accuracy. If the immersion length is too small then errors in the measurement are caused by heat conduction via the process connection and the container wall. If installing into a pipe then the immersion length should ideally be half of the pipe diameter.

- Installation possibilities: Pipes, tanks or other plant components
- To minimize the error caused by heat conduction, a minimum immersion length is recommended depending on the type of sensor used and the design of the insert. This immersion depth corresponds to the minimum insertion length for the calibration.
- ATEX certification: Observe the installation instructions in the Ex documentation! (→ 48)

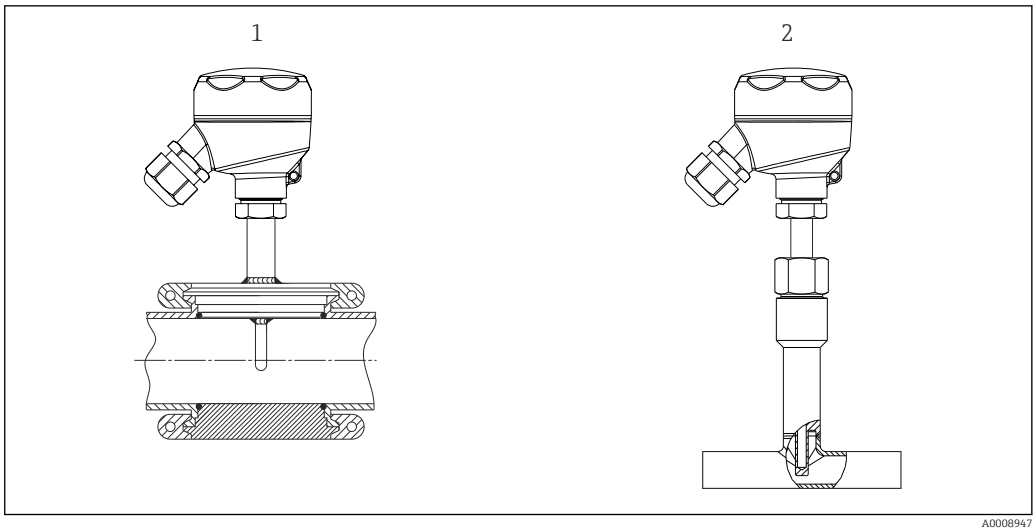


3 Installation examples

1, 2 Perpendicular to the flow direction, installed at a minimum angle of 3° to ensure self-draining
3 On elbows
4 Inclined installation in pipes with a small nominal diameter
U Immersion length

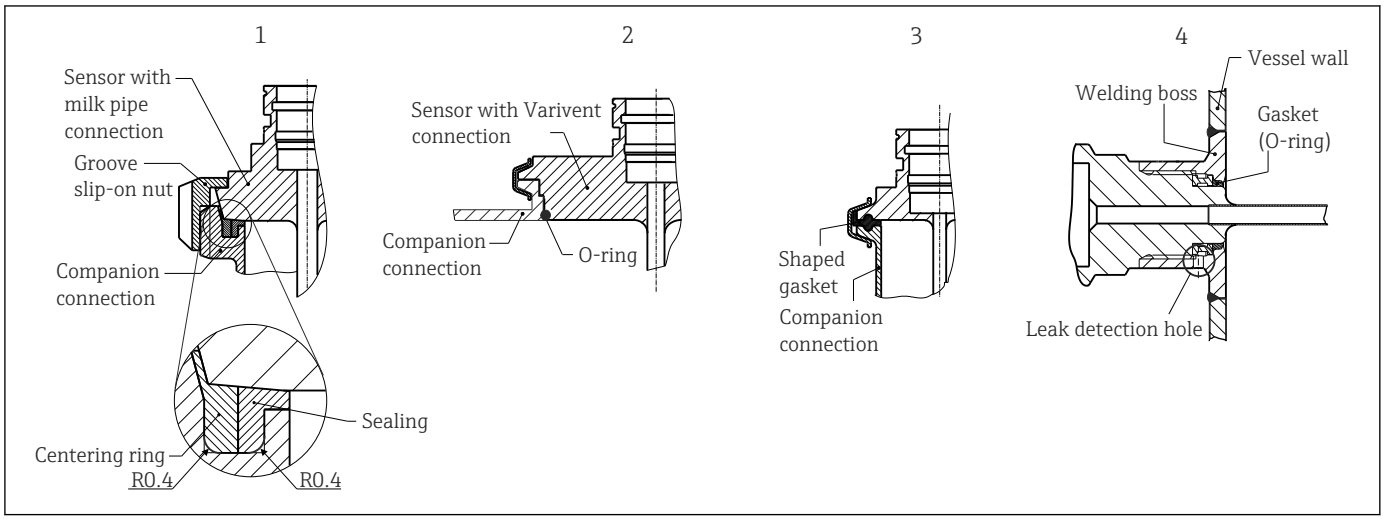
In the case of pipes with a small nominal diameter, it is advisable for the tip of the thermometer to project well into the process so that it extends past the pipe axis. Installation at an angle (4) could be another solution. When determining the immersion length or installation depth all the parameters of the thermometer and of the medium to be measured must be taken into account (e.g. flow velocity, process pressure).

The use of iTHERM QuickSens inserts is recommended for immersion lengths U < 70 mm (27.6 in).



4 *Process connections for thermometer installation in pipes with small nominal diameters*

1 *Varivent® process connection type N for DN40*
2 *Corner-piece or T-piece (illustrated) for weld-in as per DIN 11865 / ASME BPE 2012*



5 *Detailed installation instructions for hygiene-compliant installation*

1 *Sanitary connection according to DIN 11851, only in connection with EHEDG-certified and self-centering sealing ring*
2 *Varivent® process connection for VARINLINE® housing*
3 *Clamp according to ISO 2852*
4 *Liquiphant-M G1" process connection, horizontal installation*

The counterpieces for the process connections and the seals or sealing rings are not included in the scope of supply for the thermometer. Liquiphant M weld-in adapters with associated seal kits are available as accessories. (→ 44) In the case of weld-in connections, exercise the necessary degree of care when performing the welding work on the process side:

- Suitable welding material
- Flush-welded or with welding radius > 3.2 mm (0.13 in)
- No recesses, folds or gaps
- Honed and polished surface, Ra ≤ 0.76 µm (0.03 µin)

As a general rule, the thermometers should be installed in such a way that does not impact their ability to be cleaned (the requirements of the 3-A® Standard must be observed). The Varivent® and Liquiphant-M weld-in adapter and Ingold (+ weld-in adapter) connections enable flush-mounted installation.

Environment

Ambient temperature range

Terminal head	Temperature in °C (°F)
Without mounted head transmitter	Depends on the terminal head used and the cable gland or fieldbus connector, see 'Terminal heads' section (→ 🖹 31)
With mounted head transmitter	–40 to 85 °C (–40 to 185 °F)
With mounted head transmitter and display	–20 to 70 °C (–4 to 158 °F)

Extension neck	Temperature in °C (°F)
iTHERM QuickNeck	–50 to +140 °C (–58 to +284 °F)

Storage temperature

For information, see the ambient temperature.

Humidity

Depends on the transmitter used. If Endress+Hauser iTEMP head transmitters are used:
- Condensation permitted as per IEC 60 068-2-33
- Max. rel. humidity: 95% as per IEC 60068-2-30

Climate class

As per EN 60654-1, Class C

Degree of protection

Max. IP69K, depending on the design (terminal head, connector, etc.)

Shock and vibration resistance

The Endress+Hauser inserts meet the requirements of IEC 60751 which specify shock and vibration resistance of 3g in the range from 10 to 500 Hz. The vibration resistance at the measuring point depends on the sensor type and design, see the following table:

Version	Vibration resistance for the sensor tip
Pt100 (WW or TF)	30 m/s² (3g) [1]
iTHERM StrongSens Pt100 (TF) iTHERM QuickSens Pt100 (TF), version: Ø6 mm (0.24 in)	> 600 m/s² (60g)

1) Vibration resistance also applies for the quick-fastening iTHERM QuickNeck.

Electromagnetic compatibility (EMC)

Depends on the head transmitter used. For details see the Technical Information. (→ 🖹 48)

Process

Process temperature range

Depends on the type of sensor used, maximum –200 to +600 °C (–328 to +1 112 °F).

Thermal shock

Thermal shock resistance in CIP/SIP process with a temperature increase from +5 to +130 °C (+41 to +266 °F) within 2 seconds.

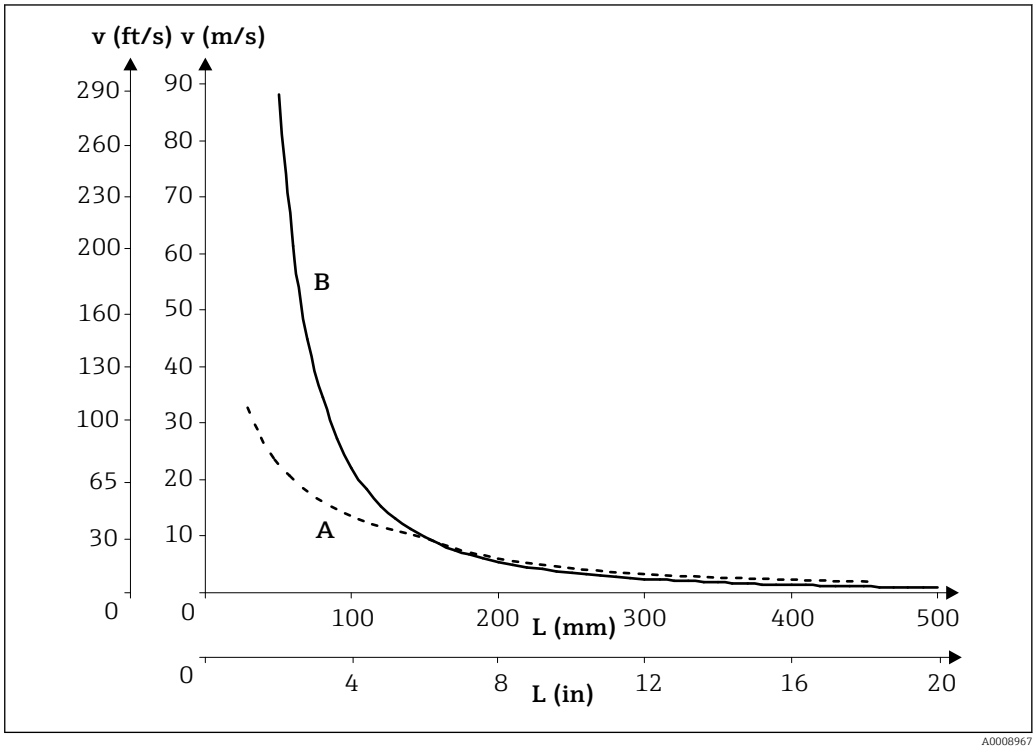
Process pressure range

The maximum possible process pressure depends on various influencing factors, such as the design, process connection and process temperature. For information on the maximum possible process pressures for the individual process connections, see the 'Process connection' section. (→ 🖹 35)

It is possible to check the mechanical loading capacity as a function of the installation and process conditions online in the TW Sizing Module for protection tubes in the Endress+Hauser Applicator software. See 'Accessories' section. (→ 🖹 47)

Example of the permitted flow velocity depending on the immersion length and process medium

The highest flow velocity tolerated by the thermometer diminishes with increasing insert immersion length exposed to the stream of the fluid. In addition it is dependent on the diameter of the thermometer tip, on the kind of measuring medium, on the process temperature and on the process pressure. The following figures exemplify the maximum permitted flow velocities in water and superheated steam at a process pressure of 40 bar (580 PSI).



6 *Permitted flow velocities, protection tube diameter 9 mm (0.35 in)*

A Medium water at T = 50 °C (122 °F)
B Medium superheated steam at T = 400 °C (752 °F)
L Immersion length exposed to flow
v Flow velocity

Medium - state of aggregation

Gaseous or liquid (also with high viscosity, e.g. yogurt).

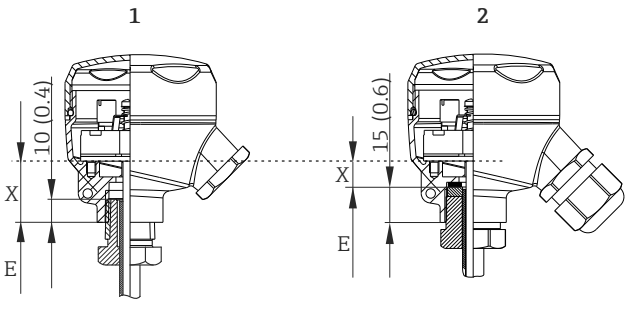
Mechanical construction

Design, dimensions

All dimensions in mm (in). The design of the thermometer depends on the protection tube version used:
- Thermometer without a protection tube
- Diameter 6 mm (¼ in)
- Diameter 9 mm (0.35 in)
- Diameter 12.7 mm (½ in)
- T-piece and corner-piece protection tube version as per DIN 11865 / ASME BPE 2012 for weld-in

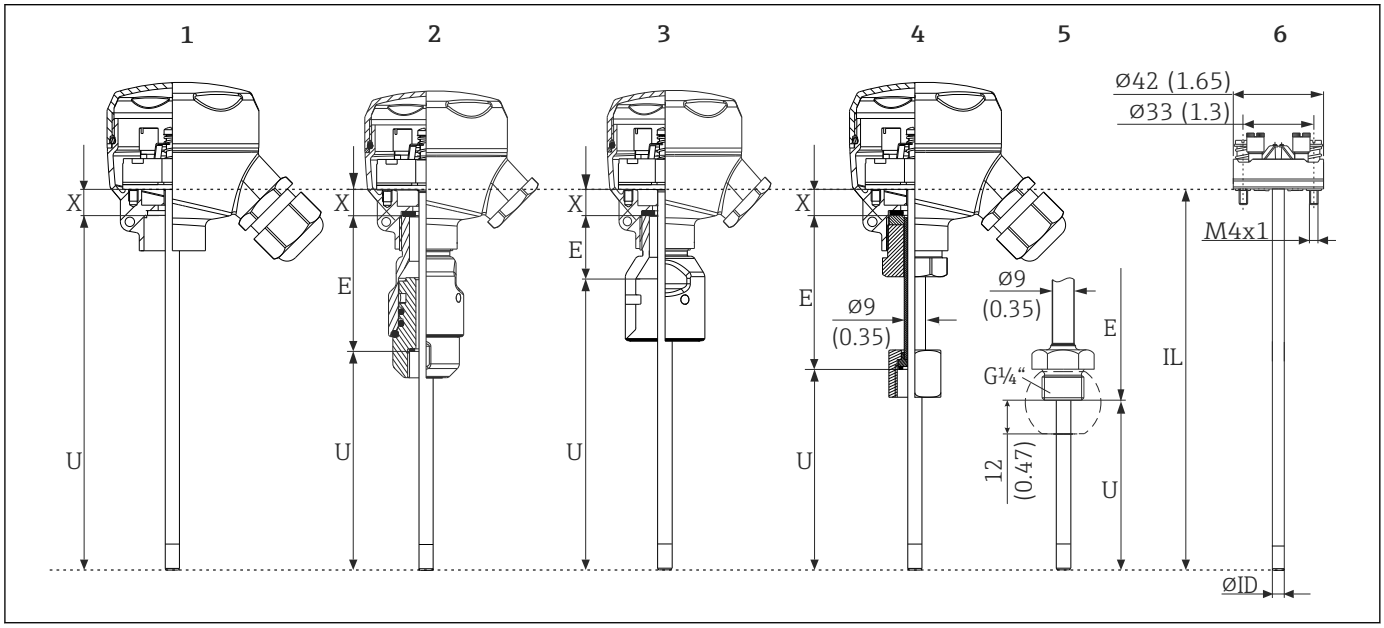
Various dimensions, such as the immersion length U for instance, are variable values and are therefore indicated as items in the following dimensional drawings.

Variable dimensions:

Item	Description
E	Extension neck length, variable depending on the configuration or predefined for the version with iTHERM QuickNeck
IL	Insertion length of insert
L	Protection tube length (U+T)
B	Protection tube base thickness: predefined, depends on protection tube version (see also the individual table data)
T	Immersion length: variable, depending on the configuration (see also the individual table data)
U	Immersion length: variable, depending on the configuration
X	Variable for calculating the insertion length of the insert, depending on different screw-in lengths in terminal head thread M24x1.5 or ½" NPT, see insert length calculation (IL) (→ 30)  7 *Different screw-in lengths in terminal head thread for M24x1.5 and ½" NPT* *1 Thread ½" NPT* *2 Thread M24x1.5*
ØID	Insert diameter 6 mm (¼ in) or 3 mm (⅛ in)

Without protection tube

For installation in an existing protection tube



1 *Thermometer without extension neck, insert surface not specified, product structure: feature 80, option A0*
2 *Thermometer with quick-fastening iTHERM QuickNeck, top and bottom part, G3/8" internal thread for protection tube connection*
3 *Thermometer with quick-fastening iTHERM QuickNeck, top part*
4 *Thermometer with replaceable extension neck TE411, G3/8" thread adapter nut for protection tube connection*
5 *Thermometer with replaceable extension neck TE411, external thread G¼" for compression fitting TK40*
6 *Insert, for example with mounted terminal block*

Can be selected for all versions: thread M24x1.5 or ½" NPT to terminal head

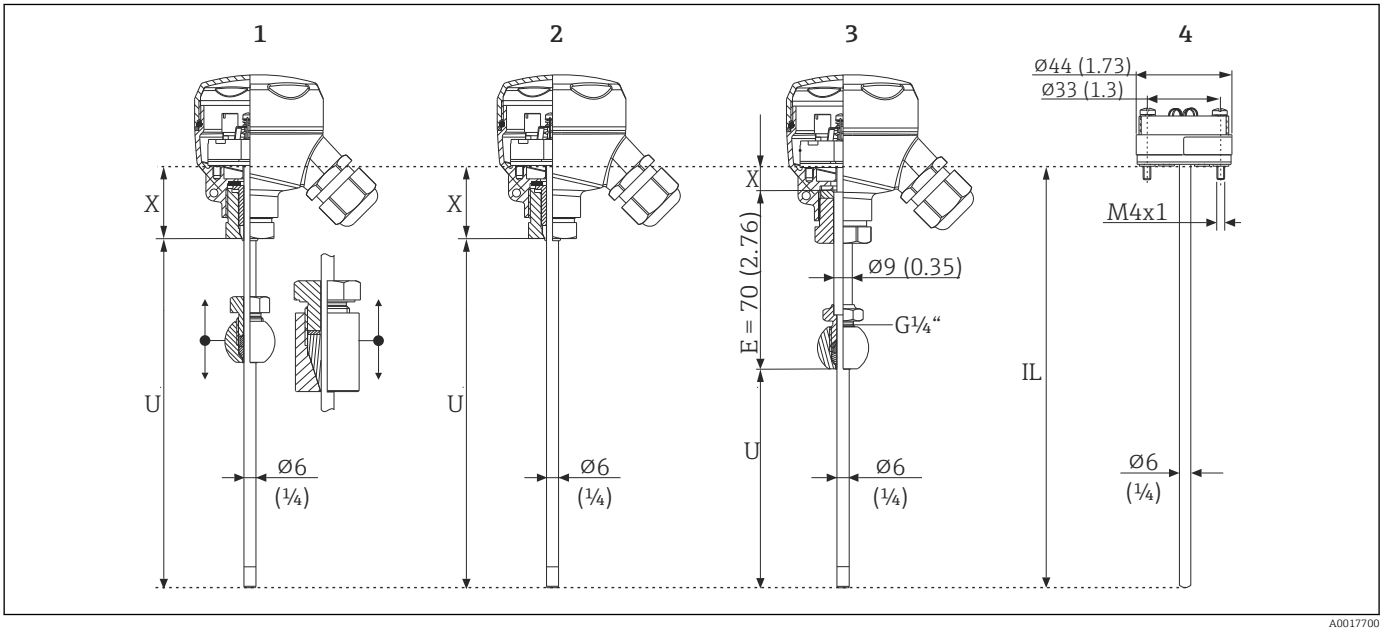
Pay attention to the following equations when calculating the immersion length U for immersion into a protection tube TT411 already available:

Version 1	Thread M24x1.5: $U = U_{\text{protection tube}} + E + T + 3$ mm (0.12 in) - B Thread ½" NPT: $U = U_{\text{protection tube}} + E + T + 18$ mm (0.71 in) - B
Version 2 and 4	$U = U_{\text{protection tube}} + T + 3$ mm (0.12 in) - B
Version 3, protection tube diameter 9 mm (0.35 in)	$U = U_{\text{protection tube}} + T + 3$ mm (0.12 in) - B
Version 3, protection tube diameter 6 mm (¼ in) / 12.7 mm (½ in)	$U = U_{\text{protection tube}} + T + 36$ mm (1.42 in) - B
Version 5	$U = U_{\text{(incl. TK40)}} + 12$ mm (0.47 in)

Item	Version	Length
Extension neck length E	**Version 2:** iTHERM QuickNeck with thread M24x1.5 to terminal head	60 mm (2.36 in)
	iTHERM QuickNeck with thread NPT ½" to terminal head	51 mm (2.00 in)
	Version 3: iTHERM QuickNeck top part with thread M24x1.5 to terminal head	30 mm (1.18 in)
	iTHERM QuickNeck top part with thread NPT ½" to terminal head	19 mm (0.75 in)
	Version 4: with replaceable extension neck, G3/8" thread adapter nut for protection tube connection	Variable, depending on the configuration

Item	Version		Length
Immersion length U	Independent of the version		Variable, depending on the configuration
Variable length X	▪ Connection thread M24x1.5:		
	– With quick-fastening iTHERM QuickNeck, top part	IL = U+X	39 mm (1.54 in)
	– With extension neck or complete iTHERM QuickNeck	IL = U+E+X	11 mm (0.43 in)
	▪ Connection thread ½" NPT:		
	– With quick-fastening iTHERM QuickNeck, top part	IL = U+X	46 mm (1.81 in)
	– With quick-fastening iTHERM QuickNeck, top part and terminal head TA30S	IL = U+X	51 mm (2 in)
	– With extension neck or complete iTHERM QuickNeck	IL = U+E+X	26 mm (1.02 in)
	– With extension neck or complete iTHERM QuickNeck and terminal head TA30S	IL = U+E+X	31 mm (1.22 in)

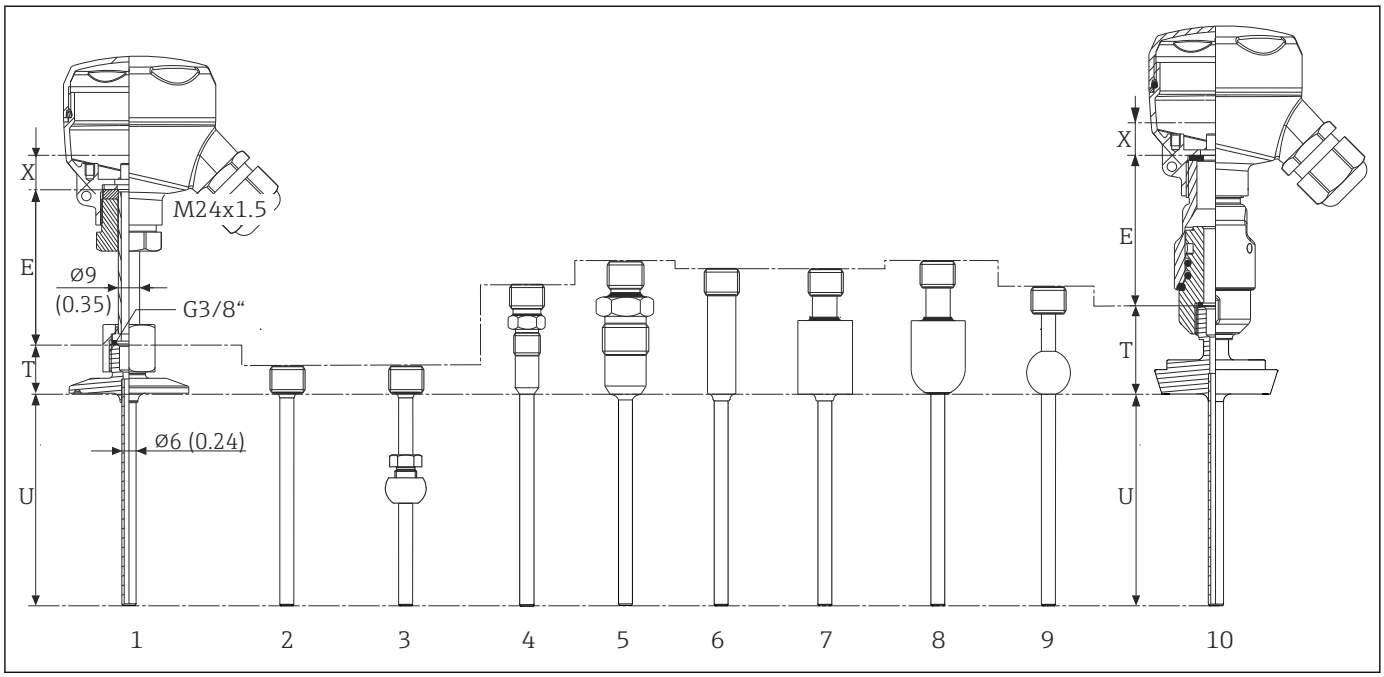
With compression fitting TK40 as process connection, insert in direct contact with the process



1 *Movable compression fitting TK40 - variably fixable immersion length U, connection thread M24x1.5*
2 *Without compression fitting for use if compression fitting is available at point of installation, insert with polished surface - product structure: feature 80, option A1 or A3*
3 *Compression fitting TK40 fixed by extension neck - fixed immersion length U, connection thread M24x1.5 or ½" NPT*
4 *Insert, for example with mounted head transmitter*

Item	Version		Length
Extension neck length E	Extension neck ø9 mm (0.35 in)		70 mm (2.76 in)
Immersion length U	Independent of the version		Variable, depending on the configuration
Variable length X	▪ With extension neck, connection thread M24x1.5	IL = U+E+X	11 mm (0.43 in)
	▪ With extension neck, connection thread ½" NPT	IL = U+E+X	26 mm (1.02 in)
	▪ With extension neck and TA30S terminal head	IL = U+E+X	31 mm (1.22 in)
	▪ Without extension neck, connection thread M24x1.5	IL = U+X	37 mm (1.46 in)

With protection tube diameter 6 mm (¼ in)



1 Thermometer with replaceable extension neck TE411 and process connection as clamp version
2 Without process connection
3 Process connection version as spherical compression fitting TK40
4 Process connection version as metal sealing system M12x1
5 Process connection version as metal sealing system G½"
6 Process connection version as cylindrical weld-in adapter Φ12 x 40 mm
7 Process connection version as cylindrical weld-in adapter Φ30 x 40 mm
8 Process connection version as spherical-cylindrical weld-in adapter Φ30 x 40 mm
9 Process connection version as spherical weld-in adapter Φ25 mm
10 Thermometer with quick-fastening iTHERM QuickNeck and process connection as sanitary connection according to DIN 11851

- Replaceable extension neck or quick-fastening iTHERM QuickNeck
- Thread M24x1.5 or ½" NPT to terminal head
- G3/8" thread for protection tube connection

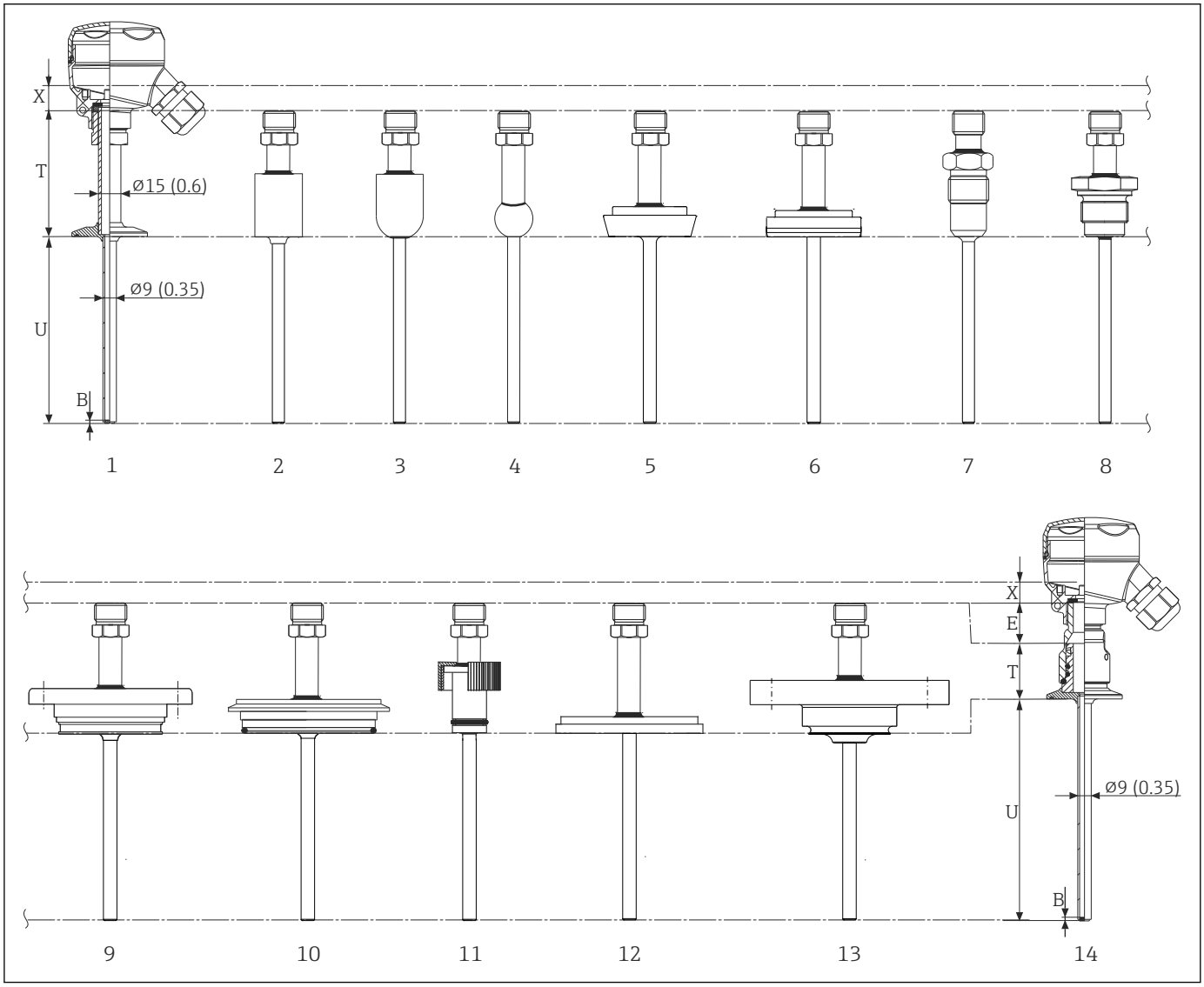
Item	Version	Length
Extension neck length E	Replaceable extension neck Φ9 mm (0.35 in)	Variable, depending on the configuration
	iTHERM QuickNeck with thread M24x1.5 to terminal head	60 mm (2.36 in)
	iTHERM QuickNeck with thread NPT ½" to terminal head	51 mm (2.00 in)
Length of protection tube shaft T [1)]	Metal sealing system M12x1	46 mm (1.81 in)
	Metal sealing system G½"	60 mm (2.36 in)
	Tri-clamp (0.5"-0.75")	24 mm (0.94 in)
	Microclamp (DN8-18)	23 mm (0.91 in)
	Clamp DN12 according to ISO 2852	24 mm (0.94 in)
	Clamp DN25/DN40 according to ISO 2852	21 mm (0.83 in)
	Sanitary connection DN25/DN32/DN40 according to DIN 11851	29 mm (1.14 in)
	Spherical-cylindrical weld-in adapter	59 mm (2.32 in)
	Cylindrical weld-in adapter Φ12 mm (0.47 in)	55 mm (2.17 in)

Item	Version	Length
	Without process connection (only G3/8" thread), where necessary with compression fitting TK40	11 mm (0.43 in)
	Cylindrical weld-in adapter	55 mm (2.17 in)
	Spherical weld-in adapter	47 mm (1.85 in)
Immersion length U	Independent of the version	Variable, depending on the configuration
Variable length X	▪ With connection thread M24x1.5 ▪ With connection thread ½" NPT ▪ With terminal head TA30S Calculation of IL for the insert: IL = U+T+E-B+X	14 mm (0.55 in) 29 mm (1.14 in) 34 mm (1.34 in)
Base thickness B	Reduced tip ⌀4.3 mm (0.17 in)	2 mm (0.08 in)

1) Depends on the process connection

With protection tube diameter 9 mm (0.35 in)

Extension neck not replaceable, but can be separated with the option of the quick-fastening iTHERM QuickNeck.

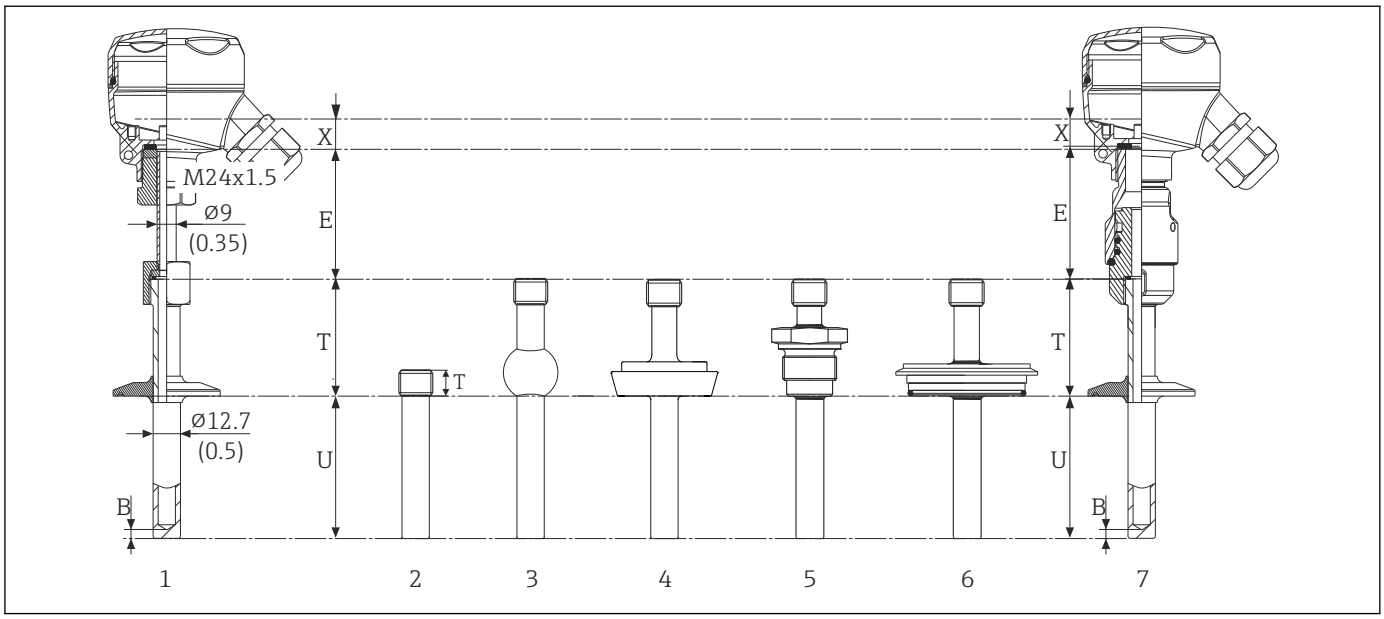


1 Thermometer without replaceable extension neck, connection thread M24x1.5, process connection as clamp-version
2 Process connection version as spherical weld-in adapter Φ30 x 40 mm
3 Process connection version as spherical-cylindrical weld-in adapter Φ30 x 40 mm
4 Process connection version as spherical weld-in adapter Φ25 mm
5 Process connection version as sanitary connection according to DIN 11851
6 Process connection version as aseptic pipe union according to DIN 11864-1 Form A
7 Process connection version as metal sealing system G½"
8 Process connection version as thread according to ISO 228 for Liquiphant weld-in adapter
9 Process connection version APV Inline
10 Process connection version Varivent®
11 Process connection version Ingold connection
12 Process connection version SMS 1147
13 Process connection version Neumo Biocontrol
14 Thermometer with quick-fastening iTHERM QuickNeck, separable, and process connection as clamp-version, for example

Item	Version	Length
Extension neck length E	Without iTHERM QuickNeck	0
	With iTHERM QuickNeck ▪ With thread M24x1.5 to terminal head ▪ With thread ½" NPT to terminal head	 ▪ 28 mm (1.1 in) ▪ 19.5 mm (0.8 in)

Item	Version	Length
Length of protection tube shaft T	Without iTHERM QuickNeck	Variable, depending on the configuration
	With quick-fastening iTHERM QuickNeck, depending on the process connection:	
	SMS 1147, DN25	40 mm (1.57 in)
	SMS 1147, DN38	41 mm (1.61 in)
	SMS 1147, DN51	42 mm (1.65 in)
	Varivent®, DN25	52 mm (2.05 in)
	Varivent®, DN32	
	Varivent®, DN10	56 mm (2.2 in)
	Thread G1" according to ISO 228 for Liquiphant weld-in adapter	77 mm (3.03 in)
	Spherical-cylindrical weld-in adapter	70 mm (2.76 in)
	Cylindrical weld-in adapter	67 mm (2.64 in)
	Aseptic pipe union according to DIN11864-A, DN25	45 mm (1.77 in)
	Aseptic pipe union according to DIN11864-A, DN40	
	Sanitary connection according to DIN 11851, DN32	47 mm (1.85 in)
	Sanitary connection according to DIN 11851, DN40	
	Sanitary connection according to DIN 11851, DN50	48 mm (1.89 in)
	Clamp according to ISO 2852, DN12	
	Clamp according to ISO 2852, DN25	37 mm (1.46 in)
	Clamp according to ISO 2852, DN40	39 mm (1.54 in)
	Clamp according to ISO 2852, DN63.5	
	Clamp according to ISO 2852, DN70	
	Microclamp (DN8-18)	47 mm (1.85 in)
	Tri-clamp (0.5"-0.75")	46 mm (1.81 in)
	Ingold connection Φ25 mm (0.98 in) x 30 mm (1.18 in)	78 mm (3.07 in)
	Ingold connection Φ25 mm (0.98 in) x 46 mm (1.81 in)	94 mm (3.7 in)
	Metal sealing system G½"	77 mm (3.03 in)
	APV-Inline, DN50	51 mm (2.01 in)
Immersion length U	Independent of the version	Variable, depending on the configuration
Variable length X	▪ Without iTHERM QuickNeck, connection thread M24x1.5 IL = U+T-B+X ▪ With iTHERM QuickNeck, connection thread M24x1.5 IL = U+E+T-B+X ▪ With iTHERM QuickNeck, connection thread ½" NPT IL = U+E+T-B+X ▪ With iTHERM QuickNeck, terminal head TA30S IL = U+E+T-B+X	14 mm (0.55 in) 14 mm (0.55 in) 29 mm (1.14 in) 34 mm (1.34 in)
Base thickness B	Reduced tip Φ5.3 mm (0.21 in) x 20 mm (0.79 in)	2 mm (0.08 in)
	Tapered tip Φ6.6 mm (0.26 in) x 60 mm (2.36 in)	
	Straight tip	

With protection tube diameter 12.7 mm (½ in)

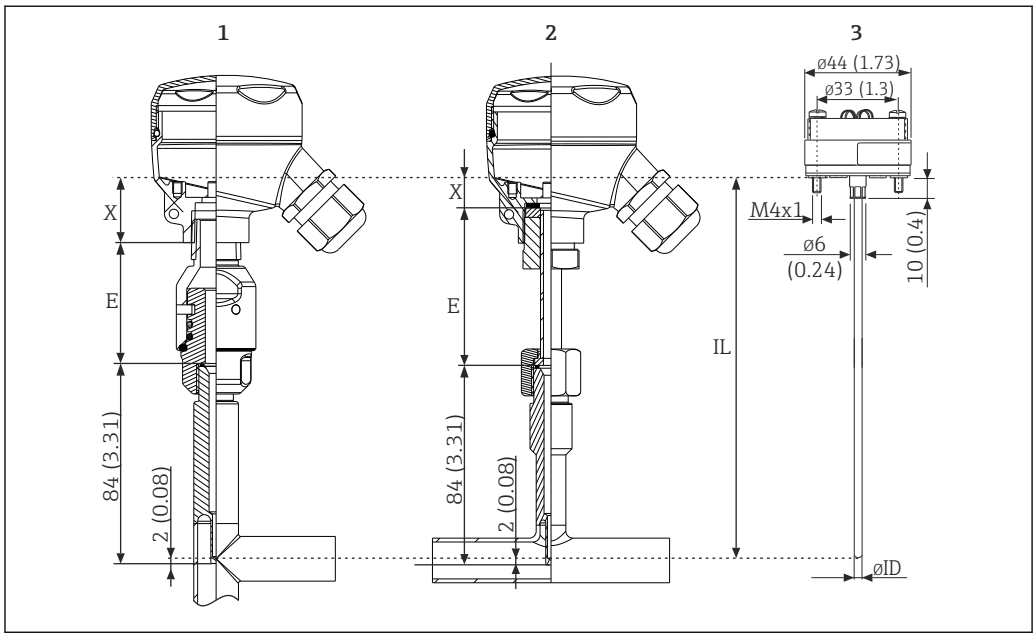


1 Thermometer with replaceable extension neck TE411 and process connection as clamp-version
2 Process connection version as cylindrical weld-in adapter Φ12.7 mm (0.5 in)
3 Process connection version as spherical weld-in adapter Φ25 mm
4 Process connection version as sanitary connection according to DIN 11851
5 Thread according to ISO 228 for Liquiphant weld-in adapter
6 Process connection version Varivent®
7 Thermometer with quick-fastening iTHERM QuickNeck and process connection as clamp-version, for example

- Replaceable extension neck or quick-fastening iTHERM QuickNeck
- G3/8" thread for protection tube connection
- Protection tube made from solid bar stock drilled for L ≤ 200 mm (7.87 in)
- Welded protection tube for L > 200 mm (7.87 in)

Item	Version	Length
Extension neck length E	Replaceable extension neck, Φ9 mm (0.35 in)	Variable, depending on the configuration
	iTHERM QuickNeck with thread M24x1.5 to terminal head	60 mm (2.36 in)
	iTHERM QuickNeck with thread NPT ½" to terminal head	51 mm (2 in)
Length of protection tube shaft T	Weld-in adapter, cylindrical, Φ12.7 mm (0.5 in)	12 mm (0.47 in)
	All other process connections	65 mm (2.56 in)
Immersion length U	Independent of the process connection	Variable, depending on the configuration
Variable length X	▪ With connection thread M24x1.5 ▪ With connection thread ½" NPT ▪ With terminal head TA30S Calculation of IL for the insert: IL = U+T+E-B+X	14 mm (0.55 in) 29 mm (1.14 in) 34 mm (1.34 in)
Base thickness B	Reduced tip Φ5.3 mm (0.21 in) x 20 mm (0.79 in)	2 mm (0.079 in)
	Reduced tip Φ8 mm (0.31 in) x 32 mm (1.26 in)	4 mm (0.16 in)
	Straight tip	6 mm (0.24 in)

With T-piece or corner-piece protection tube version



1 Thermometer with quick-fastening iTHERM QuickNeck and corner-piece protection tube, connection thread ½" NPT (also available with M24x1.5)
2 Thermometer with replaceable extension neck TE411 and T-piece protection tube, connection thread M24x1.5 (also available with ½" NPT)
3 Insert, for example with mounted head transmitter

- Dimensions as per DIN 11865 / ASME BPE 2012
- With replaceable extension neck or quick-fastening iTHERM QuickNeck
- G3/8" thread for protection tube connection

Item	Version	Length
Extension neck length E	Replaceable extension neck	Variable, depending on the configuration
	iTHERM QuickNeck with thread M24x1.5 to terminal head	60 mm (2.36 in)
	iTHERM QuickNeck with thread NPT ½" to terminal head	51 mm (2 in)
Variable length X	▪ With connection thread M24x1.5 ▪ With connection thread ½" NPT ▪ With terminal head TA30S Calculation of IL for the insert: IL = U+T+E-B+X	14 mm (0.55 in) 29 mm (1.14 in) 34 mm (1.34 in)
Base thickness B	Independent of the version	2 mm (0.079 in)

Possible combinations of the protection tube versions with the available process connections and quick-fastening iTHERM QuickNeck

Process connection and size	Protection tube diameter			iTHERM QuickNeck for ϕ9 mm (0.35 in) [1]
	6 mm (¼ in)	9 mm (0.35 in)	12.7 mm (½ in)	
Without process connection (for installation with compression fitting)	☑	-	-	-
Weld-in adapter				
Cylindrical ϕ12.7 mm (0.5 in)	-	-	☑	-
Cylindrical ϕ30 x 40 mm	☑	☑	-	☑
Cylindrical ϕ12 x 40 mm		-	-	-
Spherical-cylindrical ϕ30 x 40 mm	☑	☑	-	☑
Spherical ϕ25 mm (0.98 in)	☑	☑	☑	-
Clamp according to ISO 2852				
Microclamp/Tri-clamp DN8 - 18 (0.5 - 0.75 in)	☑	☑	-	☑
DN12 - 21.3			☑	
DN25 -38 (1 - 1.5 in)	☑	☑	☑	☑
DN40 - 51 (2 in)				
DN63.5 (2.5 in)	-	☑	☑	☑
DN70 - 76.5 (3 in)				
Sanitary connection according to DIN 11851				
DN25	☑	☑	☑	-
DN32, DN40				☑
DN50	-			
Aseptic pipe union according to DIN 11864-1 Form A				
DN25, DN40	-	☑	-	☑
Metal sealing system				
M12x1	☑	-	-	-
G½"		☑		☑
Thread according to ISO 228 for Liquiphant weld-in adapter				
G¾" for FTL20	-	☑	☑	-
G¾" for FTL50				-
G1" for FTL50				☑
APV Inline				
DN50	-	☑	-	☑
Varivent®				
Type B, ϕ31 mm; Type F, ϕ50 mm ; Type N, ϕ68 mm	-	☑	☑	☑
Ingold connection				
25 x 30 mm or 25 x 46 mm	-	☑	-	☑
SMS 1147				
DN25, DN38, DN51	-	☑	-	☑
Neumo Biocontrol				
D25 PN16, D50 PN16, D65 PN16	-	☑	-	-

1) In the case of 6 mm (¼ in) and 12.7 mm (½ in) diameters, the iTHERM QuickNeck is available for all process connection versions.

Insert

Depending on the application, iTHERM TS111 inserts with different RTD sensors are available for the thermometer:

Sensor	Standard thin-film	iTHERM StrongSens	iTHERM QuickSens [1]	Wire wound	
Sensor design; connection method	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire ▪ Φ6 mm (¼ in), mineral insulated ▪ Φ3 mm (⅛ in), teflon insulated	1x Pt100, 3- or 4-wire, mineral insulated	2x Pt100, 3-wire, mineral insulated
Vibration resistance of the insert tip	Up to 3g	Enhanced vibration resistance > 60g	▪ Φ3 mm (⅛ in) up to 3g ▪ Φ6 mm (¼ in) > 60g	Up to 3g	
Measuring range; accuracy class	−50 to +400 °C (−58 to +752 °F), Class A or AA	−50 to +500 °C (−58 to +932 °F), Class A or AA	−50 to +200 °C (−58 to +392 °F), Class A or AA	−200 to +600 °C (−328 to +1 112 °F), Class A or AA	
Diameter	3 mm (⅛ in), 6 mm (¼ in)	6 mm (¼ in)	3 mm (⅛ in), 6 mm (¼ in)		

1) Recommended for immersion lengths U < 70 mm (2.76 in)

The iTHERM TS111 insert is available as a spare part. The insertion length (IL) depends on the immersion length of the protection tube (U), the length of the extension neck (E), the thickness of the base (B), the length of the protection tube shaft (L) and the variable length (X). The insertion length (IL) must be taken into consideration when replacing the unit. Formulas for calculating IL (→ 19).

For more information on the deployed insert iTHERM TS111 with enhanced vibration resistance and fast-response sensor, see the Technical Information (TI01014T/09/).

Spare parts currently available for your product can be found online at: http://www.products.endress.com/spareparts_consumables, product root: TM411. Always quote the serial number of the device when ordering spare parts! The insertion length IL is automatically calculated using the serial number.

Weight

0.5 to 2.5 kg (1 to 5.5 lbs) for standard options.

Material

Extension neck and thermowell, insert, process connection.

The temperatures for continuous operation specified in the following table are only intended as reference values for use of the various materials in air and without any significant compressive load. The maximum operating temperatures can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Designation	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316L (complies with 1.4404 or 1.4435)	X2CrNiMo17-13-2, X2CrNiMo18-14-3	650 °C (1 202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration) ▪ Increased resistance to intergranular corrosion and pitting
1.4435+316L, Delta ferrite < 1%	With regard to analytical limits, the specifications of both materials (1.4435 and 316L) are met simultaneously. In addition, the Delta ferrite content of the wetted parts is limited to <1% - including the welding seams (following Basel Standard II)		

1) Can be used to a limited extent up to 800 °C (1472 °F) for low compressive loads and in non-corrosive media. Contact your Endress+Hauser sales team for further information.

Surface roughness

Values for wetted surfaces:

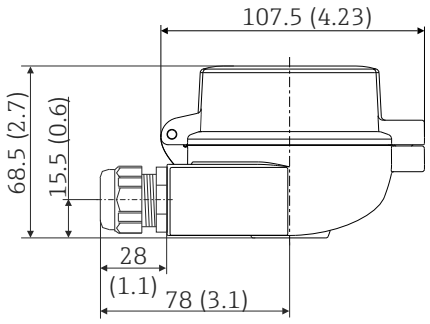
Standard surface	$R_a \leq$ 0.76 µm (0.03 µin)
Finely honed surface [1]	$R_a \leq$ 0.38 µm (0.015 µin)
Finely honed surface and electropolished	$R_a \leq$ 0.38 µm (0.015 µin)+ electropolished

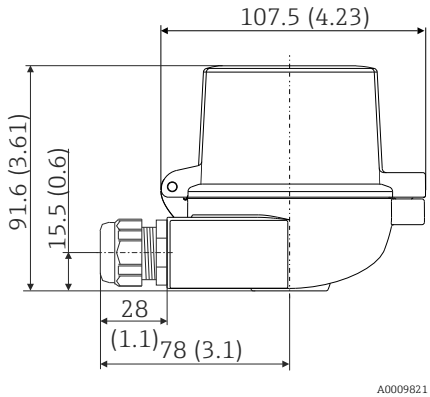
1) Not compliant with ASME BPE

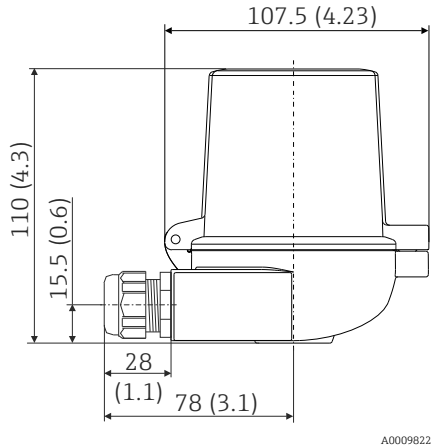
Terminal heads

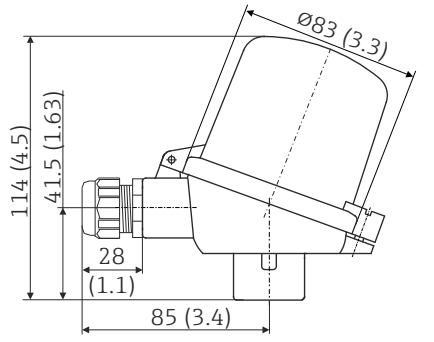
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a M24x1.5 or ½" NPT thread. All dimensions in mm (in). The cable glands in the diagrams correspond exemplary to M20x1.5 connections with polyamide cable glands for non-hazardous area. Specifications without head transmitter installed. For ambient temperatures with head transmitter installed, see the 'Environment' section. (→ 18)

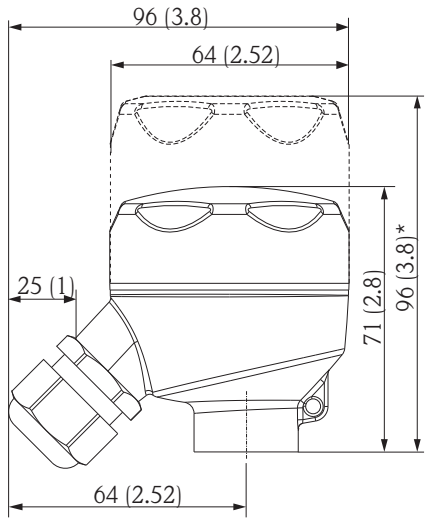
As a special feature, Endress+Hauser offers terminal heads with optimized terminal accessibility for easy installation and maintenance.

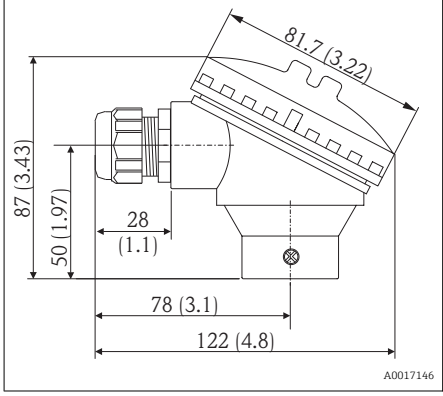
TA30A	Specification
	▪ Available with one or two cable entries ▪ Protection class: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", ½" NPT and M20x1.5; ▪ Protection armature connection: M24x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 330 g (11.64 oz) ▪ Ground terminal, internal and external ▪ With 3-A® symbol

TA30A with display window	Specification
	▪ Available with one or two cable entries ▪ Protection class: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", ½" NPT and M20x1.5 ▪ Protection armature connection: M24x1.5 ▪ Head color: blue, RAL 5012 Cap color: gray, RAL 7035 ▪ Weight: 420 g (14.81 oz) ▪ With TID10 display ▪ Ground terminal, internal and external ▪ With 3-A® symbol

TA30D	Specification
	▪ Available with one or two cable entries ▪ Protection class: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", ½" NPT and M20x1.5 ▪ Protection armature connection: M24x1.5 ▪ Two head transmitters can be mounted. In the standard version, one transmitter is mounted in the terminal head cover and an additional terminal block is installed directly on the insert. ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 390 g (13.75 oz) ▪ Ground terminal, internal and external ▪ With 3-A® symbol

TA30P	Specification
	▪ Schutzart: IP65 ▪ Max. temperature: −40 to +120 °C (−40 to +248 °F) ▪ Material: polyamide (PA), antistatic Seals: silicone ▪ Threaded cable entry: M20x1.5 ▪ Protection armature connection: M24x1.5 ▪ Head and cap color: black ▪ Weight: 135 g (4.8 oz) ▪ Types of protection for use in hazardous locations: Intrinsic Safety (G Ex ia) ▪ Ground terminal: only internal via auxiliary clamp

TA30R (optionally with display window in cover)	Specification
 * Dimensions of version with display window in cover	▪ Degree of protection - standard version: IP69K (NEMA Type 4x encl.) Degree of protection - version with display window: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +130 °C (−58 to +266 °F) without cable gland ▪ Material: stainless steel 316L/1.4404, abrasive-blasted or hand-polished Seals: silicone, optional EPDM for applications free from paint-wetting impairment substances Display window: Polycarbonate (PC) ▪ Cable entry thread ½" NPT and M20x1.5 ▪ Weight – Standard version: 360 g (12.7 oz) – Version with display window: 460 g (16.23 oz) ▪ Display window in cover optionally for head transmitter with display TID10 ▪ Protection armature connection: M24x1.5 or ½" NPT ▪ Ground terminal: internal in standard version; external terminal optionally available ▪ With 3-A® symbol

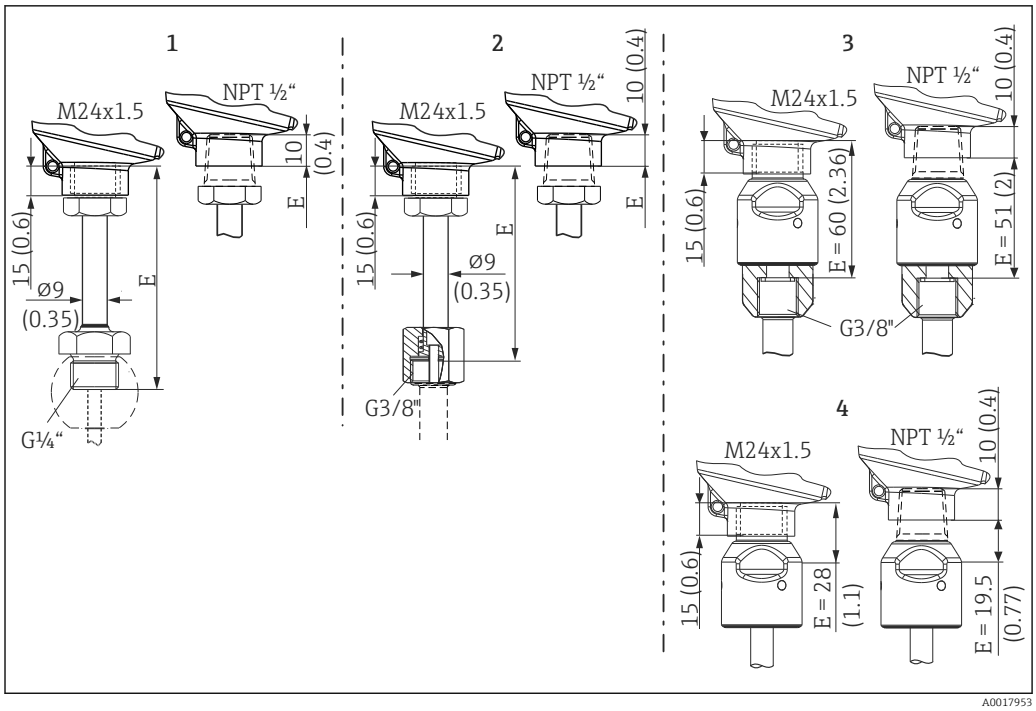
TA30S	Specification
	▪ Degree of protection: IP65 (NEMA Type 4x encl.) ▪ Temperature: −40 to +85 °C (−40 to +185 °F) without cable gland ▪ Material: polypropylene (PP), FDA-compliant, seals: O-ring EPDM ▪ Cable entry thread: ¾" NPT (with adapter for ½" NPT), M20x1.5 ▪ Protective assembly connection: ½" NPT ▪ Color: white ▪ Weight: approx. 100 g (3.5 oz) ▪ Ground terminal: only internal via auxiliary terminal ▪ With 3-A® symbol

Cable glands and fieldbus connectors

Type	Suitable for cable entry	Degree of protection	Temperature range
Cable gland, polyamide	½" NPT, ¾" NPT, M20x1.5 (optionally 2x cable entry)	IP68	−40 to +100 °C (−40 to +212 °F)
	½" NPT, M20x1.5 (optionally 2x cable entry)	IP69K	
Cable gland for dust ignition-proof area, polyamide	½" NPT, M20x1.5	IP68	−20 to +95 °C (−4 to +203 °F)
Cable gland for dust ignition-proof area, brass	M20x1.5	IP68 (NEMA Type 4x)	−20 to +130 °C (−4 to +266 °F)
Fieldbus connector (M12x1 PA, 7/8" PA, FF)	½" NPT, M20x1.5	IP67, NEMA Type 6	−40 to +105 °C (−40 to +221 °F)
Fieldbus connector (M12, 8-pin)	M20x1.5	IP67	−30 to +90 °C (−22 to +194 °F)

Extension neck

Standard version of extension neck, or optionally with the quick-fastening iTHERM QuickNeck.
- Tool-free removal of the insert:
  - Saves time/costs on frequently calibrated measuring points
  - Wiring mistakes avoided
- IP69K protection class



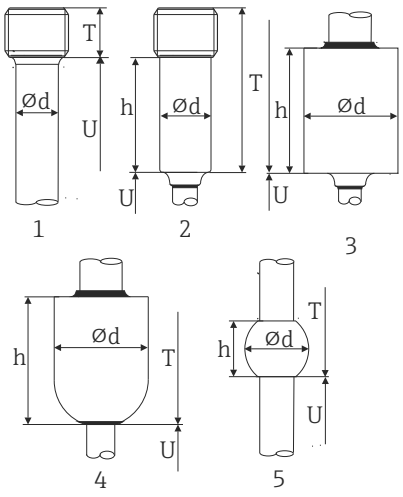
8 Dimensions of extension neck type TE411, different versions, each with M24x1.5 or NPT ½" thread to the terminal head

1 With G¼" external thread for compression fitting TK40, with 3-A® symbol
2 With G3/8" thread adapter nut for thermowell version: Φ6 mm (¼ in), Φ12.7 mm (0.5 in) and T-piece and corner-piece thermowell versions
3 Quick-fastening iTHERM QuickNeck for thermowell version: Φ6 mm (¼ in), Φ12.7 mm (0.5 in) and T-piece and corner-piece thermowell versions
4 Quick-fastening iTHERM QuickNeck - top part, for installation in an existing thermowell with iTHERM QuickNeck

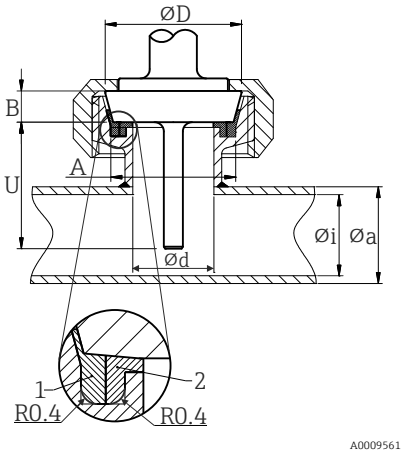
Protection tube **Process connections**

All dimensions in mm (in).

For welding in

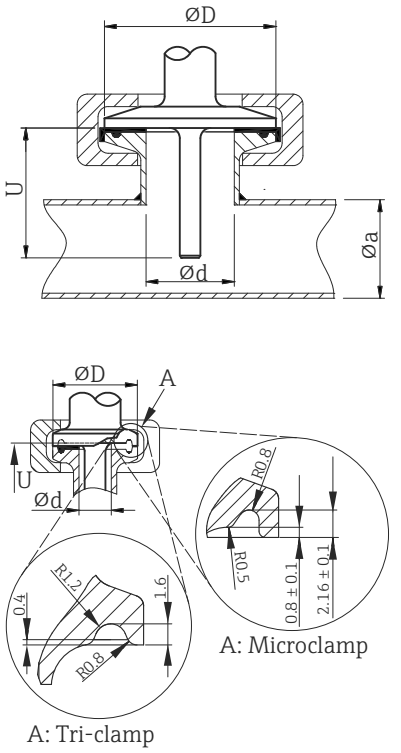
Type	Version	Dimensions	Technical properties
Weld-in adapter 	1: Cylindrical [1]	Φd = 12.7 mm (½ in), U = immersion length from lower edge of thread, T = 12 mm (0.47 in)	▪ $P_{max.}$ depends on the weld-in process ▪ With 3-A® symbol and EHEDG certification ▪ ASME BPE compliance
	2: Cylindrical [2]	Φd x h = 12 mm (0.47 in) x 40 mm (1.57 in), T = 55 mm (2.17 in)	
	3: Cylindrical	Φd x h = 30 mm (1.18 in) x 40 mm (1.57 in)	
	4: Spherical-cylindrical	Φd x h = 30 mm (1.18 in) x 40 mm (1.57 in)	
	5: Spherical	Φd = 25 mm (0.98 in) h = 24 mm (0.94 in)	

1) For protection tube Φ12.7 mm (½ in)
2) For protection tube Φ6 mm (¼ in)

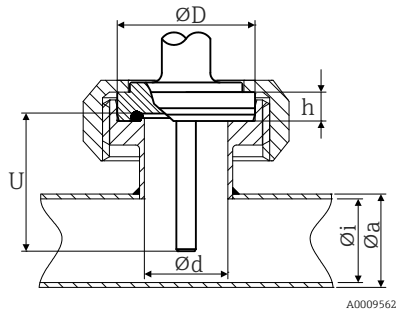
Type	Version [1]	Dimensions					Technical properties	
		ΦD	A	B	Φi	Φa	$P_{max.}$	
Sanitary connection according to DIN 11851  *1 Centering ring* *2 Sealing ring*	DN25	44 mm (1.73 in)	30 mm (1.18 in)	10 mm (0.39 in)	26 mm (1.02 in)	29 mm (1.14 in)	40 bar (580 psi)	▪ With 3-A® symbol and EHEDG certification (only with EHEDG-certified and self-centering sealing ring). ▪ ASME BPE compliance
	DN32	50 mm (1.97 in)	36 mm (1.42 in)		32 mm (1.26 in)	35 mm (1.38 in)		
	DN40	56 mm (2.2 in)	42 mm (1.65 in)		38 mm (1.5 in)	41 mm (1.61 in)		
	DN50	68 mm (2.68 in)	54 mm (2.13 in)	11 mm (0.43 in)	50 mm (1.97 in)	53 mm (2.1 in)	25 bar (363 psi)	

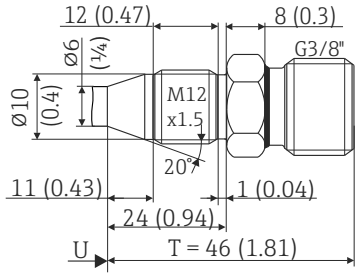
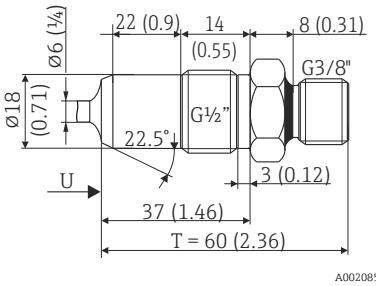
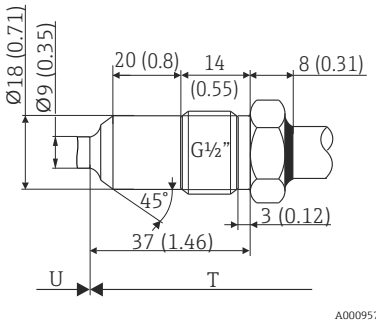
1) Pipes in accordance with DIN 11850

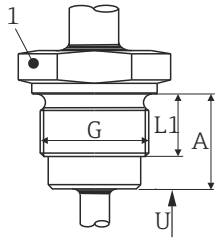
Releasable process connection

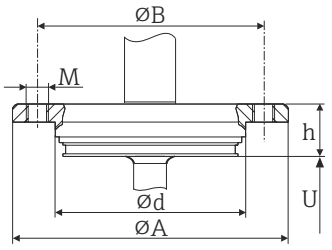
Type	Version	Dimensions		Technical properties
	ϕd [1]	ϕD	ϕa	
Clamp according to ISO 2852  *A Variable sealing geometry for Microclamp and Tri-clamp*	Microclamp [2] DN8-18 (0.5"-0.75")	25 mm (0.98 in)	-	▪ $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal ▪ With 3-A® symbol
	Tri-clamp DN8-18 (0.5"-0.75")		-	
	DN12-21.3	34 mm (1.34 in)	16 to 25.3 mm (0.63 to 0.99 in)	▪ $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal ▪ With 3-A® symbol and EHEDG certification (combined with Hyjoin PEEK/(stainless steel seal or Dupont de Nemours Kalrez/ stainless steel seal) ▪ Compliant with ASME BPE [3]
	DN25-38 (1"-1.5")	50.5 mm (1.99 in)	29 to 42.4 mm (1.14 to 1.67 in)	
	DN40-51 (2")	64 mm (2.52 in)	44.8 to 55.8 mm (1.76 to 2.2 in)	
	DN63.5 (2.5")	77.5 mm (3.05 in)	68.9 to 75.8 mm (2.71 to 2.98 in)	
	DN70-76.5 (3")	91 mm (3.58 in)	> 75.8 mm (2.98 in)	

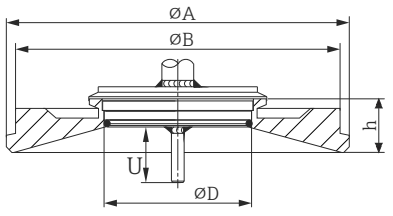
1) Pipes in accordance with ISO 2037 and BS 4825 Part 1
2) Microclamp (not in ISO 2852); no standard pipes
3) Not for DN12-21.3

Type	Version	Dimensions					Technical properties
		ϕd	ϕD	ϕi	ϕa	h	
Aseptic pipe union according to DIN 11864-1, Form A 	DN25	26 mm (1.02 in)	42.9 mm (1.7 in)	26 mm (1.02 in)	29 mm (1.14 in)	9 mm (0.35 in)	▪ $P_{max.}$ = 40 bar (580 psi) ▪ With 3-A® symbol and EHEDG certification ▪ ASME BPE compliance
	DN40	38 mm (1.5 in)	54.9 mm (2.16 in)	38 mm (1.5 in)	41 mm (1.61 in)	10 mm (0.39 in)	

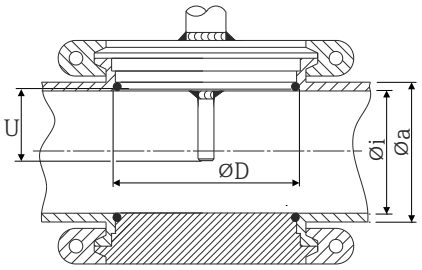
Type		Version	Technical properties
Metal sealing system		Protection tube diameter 6 mm (¼ in)	▪ $P_{max.}$ = 16 bar (232 psi) ▪ EHEDG certified
M12x1.5	**G½"**		
			
-		Protection tube diameter 9 mm (0.35 in)	▪ $P_{max.}$ = 16 bar (232 psi) ▪ EHEDG certified

Type	Version G	Dimensions			Technical properties
		L1 thread length	A	1 (SW/AF)	
Thread according to ISO 228 (for Liquiphant weld-in adapter) 	G¾" for FTL20 adapter	16 mm (0.63 in)	25.5 mm (1 in)	32	▪ $P_{max.}$ = 25 bar (362 psi) at max. 150 °C (302 °F) ▪ $P_{max.}$ = 40 bar (580 psi) at max. 100 °C (212 °F) ▪ With 3-A® symbol and EHEDG certification ▪ ASME BPE compliance
	G¾" for FTL50 adapter				
	G1" for FTL50 adapter	18.6 mm (0.73 in)	29.5 mm (1.16 in)	41	

Type	Version	Dimensions					Technical properties
		Φd	ΦA	ΦB	M	h	
APV Inline 	DN50	69 mm (2.72 in)	99.5 mm (3.92 in)	82 mm (3.23 in)	2xM8	19 mm (0.75 in)	▪ $P_{max.}$ = 25 bar (362 psi) ▪ With 3-A® symbol and EHEDG certification ▪ ASME BPE compliance

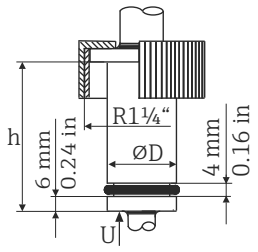
Type	Version	Dimensions				Technical properties	
		ΦD	ΦA	ΦB	h	$P_{max.}$	
Varivent® 	Type B	31 mm (1.22 in)	105 mm (4.13 in)	-	22 mm (0.87 in)	10 bar (145 psi)	▪ With 3-A® symbol and EHEDG certification ▪ ASME BPE compliance
	Type F	50 mm (1.97 in)	145 mm (5.71 in)	135 mm (5.31 in)	24 mm (0.95 in)		
	Type N	68 mm (2.67 in)	165 mm (6.5 in)	155 mm (6.1 in)	24.5 mm (0.96 in)		

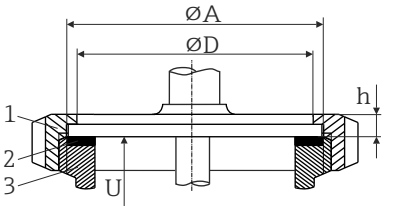
The VARINLINE® housing connection flange is suitable for weld-in into the conical or torispherical head in tanks or containers with a small diameter (≤ 1.6 m (5.25 ft)) and up to a wall thickness of 8 mm (0.31 in).

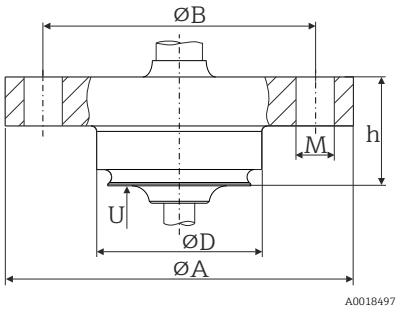
Type	Technical properties
Varivent® for VARINLINE® housing for installation in pipes 	▪ With 3-A® symbol and EHEDG certification ▪ ASME BPE compliance

Version	Dimensions			$P_{max.}$
	Φ D	Φi	Φa	
Type N, according to DIN 11866, series A	68 mm (2.67 in)	DN40: 38 mm (1.5 in)	DN40: 41 mm (1.61 in)	DN40 to DN65: 16 bar (232 psi)
		DN50: 50 mm (1.97 in)	DN50: 53 mm (2.1 in)	
		DN65: 66 mm (2.6 in)	DN65: 70 mm (2.76 in)	
		DN80: 81 mm (3.2 in)	DN80: 85 mm (3.35 in)	DN80 to DN150: 10 bar (145 psi)
		DN100: 100 mm (3.94 in)	DN100: 104 mm (4.1 in)	
		DN125: 125 mm (4.92 in)	DN125: 129 mm (5.08 in)	
		DN150: 150 mm (5.9 in)	DN150: 154 mm (6.06 in)	
Type N, according to EN ISO 1127, series B	68 mm (2.67 in)	38.4 mm (1.51 in)	42.4 mm (1.67 in)	42.4 mm (1.67 in) to 60.3 mm (2.37 in): 16 bar (232 psi)
		44.3 mm (1.75 in)	48.3 mm (1.9 in)	
		56.3 mm (2.22 in)	60.3 mm (2.37 in)	
		72.1 mm (2.84 in)	76.1 mm (3 in)	76.1 mm (3 in) to 114.3 mm (4.5 in): 10 bar (145 psi)
		82.9 mm (3.26 in)	42.4 mm (3.5 in)	
		108.3 mm (4.26 in)	114.3 mm (4.5 in)	
Type N, according to DIN 11866, series C	68 mm (2.67 in)	OD 1½": 34.9 mm (1.37 in)	OD 1½": 38.1 mm (1.5 in)	OD 1½" to OD 2½": 16 bar (232 psi)
		OD 2": 47.2 mm (1.86 in)	OD 2": 50.8 mm (2 in)	
		OD 2½": 60.2 mm (2.37 in)	OD 2½": 63.5 mm (2.5 in)	
		OD 3": 73 mm (2.87 in)	OD 3": 76.2 mm (3 in)	OD 3" to OD 4": 10 bar (145 psi)
		OD 4": 97.6 mm (3.84 in)	OD 4": 101.6 mm (4 in)	

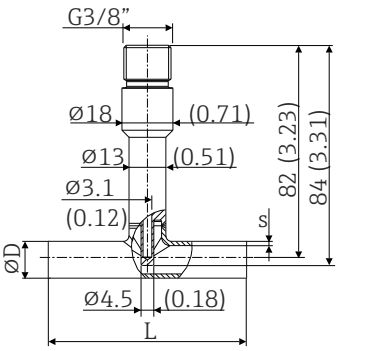
Due to the small immersion length U, the use of iTHERM QuickSens inserts is recommended.

Type	Version, dimensions ΦD x h	Technical properties
Ingold connection 	Φ25 mm (0.98 in) x 30 mm (1.18 in)	$P_{max.}$ = 25 bar (362 psi)
	Φ25 mm (0.98 in) x 46 mm (1.81 in)	

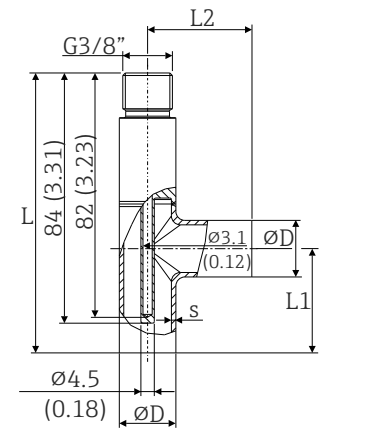
Type	Version	Dimensions			Technical properties
		ΦD	ΦA	h	
SMS 1147  *1 Thread adapter nut* *2 Sealing ring* *3 Counterpart connection*	DN25	32 mm (1.26 in)	35.5 mm (1.4 in)	7 mm (0.28 in)	$P_{max.}$ = 25 bar (362 psi)
	DN38	48 mm (1.89 in)	55 mm (2.17 in)	8 mm (0.31 in)	
	DN51	60 mm (2.36 in)	65 mm (2.56 in)	9 mm (0.35 in)	
The counterpart connection must fit the sealing ring and fix it in place.					

Type	Version	Dimensions					Technical properties
		ΦA	ΦB	ΦD	Φd	h	
Neumo Biocontrol 	D25 PN16	64 mm (2.52 in)	50 mm (1.97 in)	30.4 mm (1.2 in)	7 mm (0.28 in)	20 mm (0.79 in)	
	D50 PN16	90 mm (3.54 in)	70 mm (2.76 in)	49.9 mm (1.97 in)	9 mm (0.35 in)	27 mm (1.06 in)	▪ $P_{max.}$ = 16 bar (232 psi) ▪ With 3-A® symbol
	D65 PN25	120 mm (4.72 in)	95 mm (3.74 in)	67.9 mm (2.67 in)	11 mm (0.43 in)		

Due to the small immersion length U, the use of iTHERM QuickSens inserts is generally recommended for T-piece/corner-piece process connections according to DIN 11865.

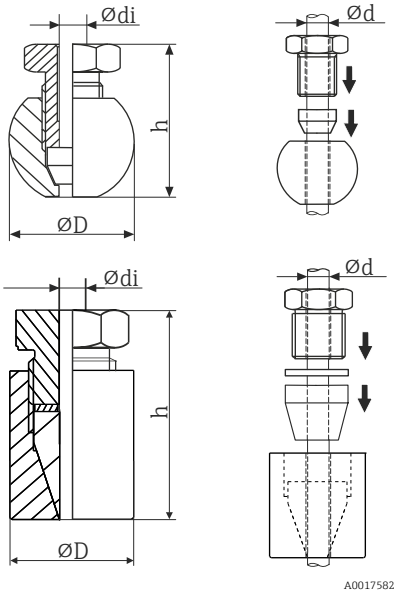
Type	Version		Dimensions in mm (in)			Technical properties
			ØD	L	s [1]	
T-piece for weld-in as per DIN 11865 (Part A, B and C)  	Part A	DN10 PN25	13 mm (0.51 in)	70 mm (2.76 in)	1.5 mm (0.06 in)	▪ $P_{max.}$ = 25 bar (362 psi) ▪ R_a ≤ 0.38 µm (0.015 µin) + electropolished
		DN15 PN25	19 mm (0.75 in)			
		DN25 PN25	29 mm (1.14 in)	100 mm (3.94 in)		
	Part B	DN13.5 PN25	13.5 mm (0.53 in)	64 mm (2.52 in)	1.6 mm (0.063 in)	
		DN17.2 PN25	17.2 mm (0.68 in)	68 mm (2.68 in)		
		DN21.3 PN25	21.3 mm (0.84 in)	72 mm (2.83 in)		
	Part C [2]	DN12.7 PN25 (½")	12.7 mm (0.5 in)	95.2 mm (3.75 in)	1.65 mm (0.065 in)	
		DN19.05 PN25 (¾")	19.05 mm (0.75 in)	101.6 mm (4 in)		
		DN38.1 PN25 (1½")	38.1 mm (1.5 in)	120.6 mm (4.75 in)		

1) Wall thickness
2) Dimensions as per ASME BPE 2012

Type	Version		Dimensions					Technical properties
			ØD	L	L1	L2	s [1]	
Corner-piece for weld-in as per DIN 11865 (Part A, B and C)  	Part A	DN10 PN25	13 mm (0.51 in)	117 mm (4.61 in)	35 mm (1.38 in)		1.5 mm (0.06 in)	▪ $P_{max.}$ = 25 bar (362 psi) ▪ R_a ≤ 0.38 µm (0.015 µin)+ electropolished
		DN15 PN25	19 mm (0.75 in)	109 mm (4.3 in)	35 mm (1.38 in)			
		DN25 PN25	29 mm (1.14 in)	119 mm (4.7 in)	50 mm (1.97 in)			
	Part B	DN13.5 PN25	13.5 mm (0.53 in)	108 mm (4.25 in)	32 mm (1.26 in)		1.6 mm (0.063 in)	
		DN17.2 PN25	17.2 mm (0.68 in)	109 mm (4.3 in)	34 mm (1.34 in)			
		DN21.3 PN25	21.3 mm (0.84 in)		36 mm (1.41 in)			
	Part C	DN12.7 PN25 (½") [2]	12.7 mm (0.5 in)	129 mm (5.08 in)	47.6 mm (1.87 in)		1.65 mm (0.065 in)	
		DN19.05 PN25 (¾")	19.05 mm (0.75 in)	133 mm (5.24 in)	50.8 mm (2.00 in)			
		DN38.1 PN25 (1½")	38.1 mm (1.5 in)	142 mm (5.6 in)	60.3 mm (2.37 in)			

1) Wall thickness
2) Dimensions as per ASME BPE 2012

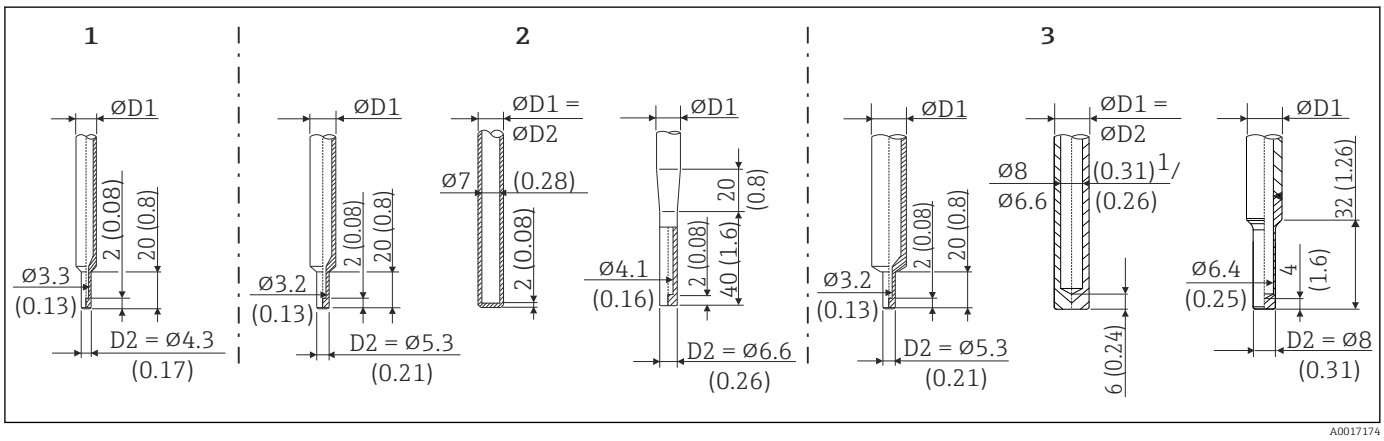
Compression fitting

Type	Version	Dimensions			Technical properties [1]
	Spherical or cylindrical	⌀di:	⌀D:	h:	
Compression fitting TK40 for weld-in 	Spherical Ferrule material PEEK or 316L Thread G¼"	6.3 mm (0.25 in)	25 mm (0.98 in)	33 mm (1.3 in)	▪ $P_{max.}$ = 10 bar (145 psi), $T_{max.}$ = +150 °C (+302 °F) for PEEK material, tightening torque = 10 Nm ▪ $P_{max.}$ = 50 bar (725 psi), $T_{max.}$ = +200 °C (+392 °F) for 316L material, tightening torque = 25 Nm ▪ PEEK ferrule is 3-A® certified
	Cylindrical Ferrule material Silopren® Thread G½"	6.2 mm (0.24 in) [2] 9.2 mm (0.36 in)	30 mm (1.18 in)	57 mm (2.24 in)	▪ $P_{max.}$ = 10 bar (145 psi) ▪ $T_{max.}$ for Silopren® ferrule = +150 °C (+302 °F), tightening torque = 5 Nm

1) All the pressure specifications apply for cyclic temperature load
2) For insert or protection tube diameter Ød = 6 mm (0.236 in).

Tip shape

The thermal response time, the reduction of the flow cross-section and the mechanical load that occurs in the process are the criteria that matter when selecting the shape of the tip. Advantages of using reduced or tapered thermometer tips:
- A smaller tip shape has less impact on the flow characteristics of the pipe carrying the medium.
- The flow characteristics are optimized, thereby increasing the stability of the protection tube.
- Endress+Hauser offers users a range of protection tube tips to meet every requirement:
  - Reduced tip with ⌀4.3 mm (0.17 in) and ⌀5.3 mm (0.21 in): walls of lower thickness significantly reduce the response times of the overall measuring point.
  - Tapered tip with ⌀6.6 mm (0.26 in) and reduced tip with ⌀8 mm (0.31 in): walls of greater thickness are particularly well suited to applications with a higher degree of mechanical load or wear (e.g. pitting, abrasion etc.).



9 Protection tube tips available (reduced, straight or tapered)

Item No.	Protection tube (ΦD1)		Insert (ΦID)
1	Φ6 mm (¼ in)	Reduced tip	Φ3 mm (⅛ in)
2	Φ9 mm (0.35 in)	▪ Reduced tip with Φ5.3 mm (0.21 in) ▪ Straight tip ▪ Tapered tip with Φ6.6 mm (0.26 in)	▪ Φ3 mm (⅛ in) ▪ Φ6 mm (¼ in) ▪ Φ3 mm (⅛ in)
3	Φ12.7 mm (½ in)	▪ Reduced tip with Φ5.3 mm (0.21 in) ▪ Straight tip [1] ▪ Reduced tip with Φ8 mm (0.31 in)	▪ Φ3 mm (⅛ in) ▪ Φ6 mm (¼ in) ▪ Φ6 mm (¼ in)

1) Internal diameter Φ8 mm (0.31 in) for protection tube made from solid bar stock drilled for total length L ≤ 200 mm (7.87 in). Φ6.6 mm (0.26 in) for welded protection tube with total length L ≥ 200 mm (7.87 in).

It is possible to check the mechanical loading capacity as a function of the installation and process conditions online in the TW Sizing Module for protection tubes in the Endress+Hauser Applicator software. See 'Accessories' section. (→ 47)

Certificates and approvals

CE mark

The measuring system meets the legal requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

Hygiene standard

- EHEDG certification, type EL CLASS I. Permitted process connections in accordance with EHEDG, see 'Process connections' section (→ 35)
- 3-A® authorization no. 1144, 3-A® sanitary standard 74-06. Permitted process connections in accordance with 3-A®, see 'Process connections' section (→ 35)
- ASME BPE, certificate of conformity can be ordered for indicated options
- FDA-compliant
- All product contact surfaces are produced without animal fats (TSE Certificate of Suitability)

Ex approval

Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Center on request. All explosion protection data are given in separate documentation which is available upon request.

Other standards and guidelines

- EN 60079: ATEX certification for hazardous areas
- IEC 60529: Degrees of protection provided by enclosures (IP code)
- IEC 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC 60751: Industrial platinum resistance thermometers
- EN 50281-1-1: Electrical apparatus protected by enclosures
- DIN 43772: Protection tubes
- DIN EN 50446: Terminal heads
- IEC 61326-1: Electromagnetic compatibility (electrical equipment for measurement, control and laboratory use - EMC requirements)

Surface roughness

- Free from oil and grease for oxygen service, optional
- PWIS-free (PWIS = paint-wetting impairment substances as per DIL0301), optional

Material certification

The material certificate 3.1 (according to standard EN 10204) can be requested separately. The "short form" certificate includes a simplified declaration with no enclosures of documents related to the materials used in the construction of the single sensor and guarantees the traceability of the materials through the identification number of the thermometer. The data related to the origin of the materials can subsequently be requested by the client if necessary.

Calibration

The "Factory calibration" is carried out according to an internal procedure in a laboratory of Endress +Hauser accredited by the European Accreditation Organization (EA) to ISO/IEC 17025. A calibration which is performed according to EA guidelines (SIT/Accredia) or (DKD/DAkkS) may be requested separately. The calibration is performed on the replaceable insert of the thermometer. In

the case of thermometers without a replaceable insert, the entire thermometer - from the process connection to the tip of the thermometer - is calibrated.

Protection tube testing and load capacity calculation

- Protection tube pressure tests are carried out in accordance with the specifications in DIN 43772. With regard to protection tubes with tapered or reduced tips that do not comply with this standard, these are tested using the pressure of corresponding straight protection tubes. Tests according to other specifications can be carried out on request. The liquid penetration test verifies that there are no cracks in the welded seams of the protection tube.
- EN1779 helium leak test, PMI test, concentricity test for drilled protection tubes, dye penetration test, TW welding, internal hydrostatic pressure, etc. each with inspection certificate
- Load capacity calculation for the protection tube as per DIN43772

Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser web site: www.endress.com → Choose your country → Products → Select measuring technology, software or components → Select product (picklists: measurement method, product family etc.) → Device support (right-hand column): Configure the selected product → The Product Configurator for the selected product is opened.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

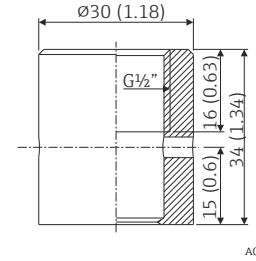
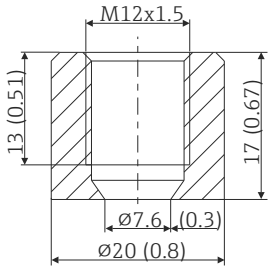
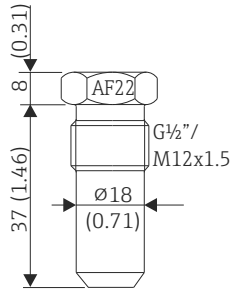
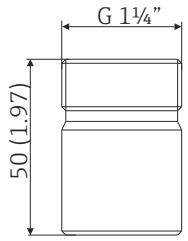
Product Configurator - the tool for individual product configuration

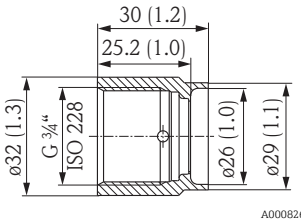
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Accessories

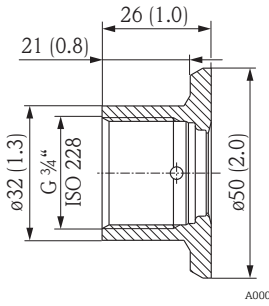
Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Device-specific accessories

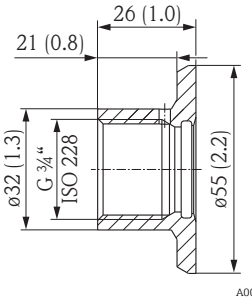
Accessories	Description
Welding boss with sealing taper (metal - metal)  A0006621  A0018236	Welding boss for G½"- and M12x1.5 thread Metal-sealing; conical Material of wetted parts: 316L/1.4435 Max. process pressure 16 bar (232 PSI) **Order number:** ▪ 60021387 (G½") ▪ 71190468 (M12x1.5)
Dummy plug  A0009213-EN	Dummy plug for G½" or M12x1.5 conical metal-sealing welding boss Material: SS 316L/1.4435 **Order number:** ▪ 60022519 (G½") ▪ 60021194 (M12x1.5)
Weld-in adapter for Ingold process connections  A0008956	Material of wetted parts: 316L/1.4435 Weight: 0.32 kg (0.7 lb) **Order number:** 60017887 O-ring seal set ▪ Silicone O-ring in accordance with FDA CFR 21 ▪ Maximum temperature: 230 °C (446 °F) ▪ **Order number:** 60018911

Weld-in adapter FTL20  	G¾", d=29 mm, without flange Material: 316L Roughness in µm (µin): 1.5 (59.1) **Order number:** 52028295 (with inspection certificate EN10204-3.1 material) **Order number** seal (5-pc. set): silicone O-ring 52021717 [1], FDA-compliant

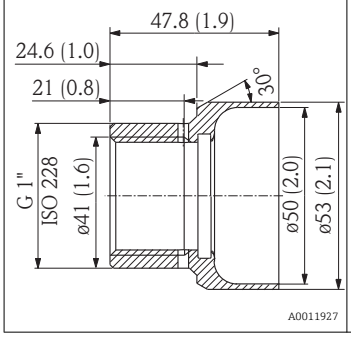
1) A seal is included in the delivery.

Weld-in adapter FTL20  	G¾", d=50 mm, with flange Material: 316L Roughness in µm (µin): 0.8 (31.5) **Order number:** 52018765 (with inspection certificate EN10204-3.1 material) **Order number** seal (5-pc. set): silicone O-ring 52021717 [1], FDA-compliant With EHEDG certification and 3-A® symbol

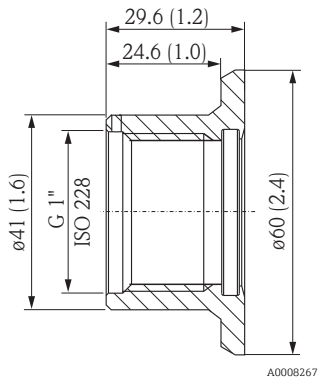
1) A seal is included in the delivery.

Weld-in adapter FTL50  	G¾", d=55 mm, with flange Material: 316L Roughness in µm (µin): 0.8 (31.5) **Order number:** 52001052 (without inspection certificate EN10204-3.1 material) **Order number:** 52011897 (with inspection certificate EN10204-3.1 material) **Order number** seal (5-pc. set): silicone O-ring 52014473 [1], FDA-compliant **Order number** weld-in dummy: MVT2L0692 With EHEDG certification and 3-A® symbol

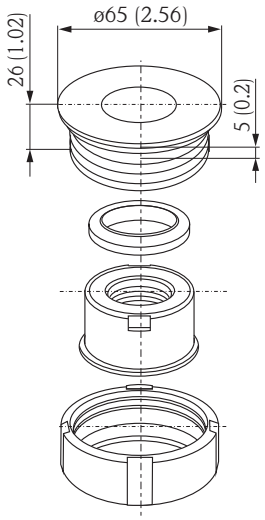
1) A seal is included in the delivery.

Weld-in adapter FTL50  	G1", d=53 mm, without flange Material: 316L Roughness in µm (µin): 0.8 (31.5) **Order number:** 71093129 (with inspection certificate EN10204-3.1 material) **Order number** seal (5-pc. set): silicone O-ring 52014472 [1], FDA-compliant **Order number** weld-in dummy: MVT2L0691

1) A seal is included in the delivery.

Weld-in adapter FTL50  	G1", d=60 mm, with flange Material: 316L Roughness in µm (µin): 0.8 (31.5) **Order number:** 52001051 (without inspection certificate EN10204-3.1 material) **Order number:** 52011896 (with inspection certificate EN10204-3.1 material) **Order number** seal (5-pc. set): silicone O-ring 52014472 [1], FDA-compliant **Order number** weld-in dummy: MVT2L0691 With EHEDG certification and 3-A® symbol

1) A seal is included in the delivery.

Weld-in adapter FTL50  	G1", can be aligned Material: 316L Roughness in µm (µin): 0.8 (31.5) **Order number:** 52001221 (without inspection certificate EN10204-3.1 material) **Order number:** 52011898 (with inspection certificate EN10204-3.1 material) **Order number** seal (5-pc. set): silicone O-ring 52014424 [1], FDA-compliant **Order number** weld-in dummy: M40167

1) A seal is included in the delivery.

Maximum process pressure for the weld-in adapters:
- 25 bar (362 PSI) at maximum 150 °C (302 °F)
- 40 bar (580 PSI) at maximum 100 °C (212 °F)

For more information on the weld-in adapters FTL20, FTL50, see Technical Information (TI00426F/00).

Communication-specific accessories

Configuration kit TXU10	Configuration kit for PC-programmable transmitter with setup software and interface cable for PC with USB port Order code: TXU10-xx
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details, see "Technical Information" TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see "Technical Information" TI00405C
HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. For details, see "Technical Information" TI00429F and Operating Instructions BA00371F

Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity. For details, see Operating Instructions BA061S
Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00053S
Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00051S
Field Xpert SFX100	Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4-20 mA). For details, see Operating Instructions BA00060S

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for local PC installation.
Konfigurator$^{+temperature}$	Software for selecting and configuring the product depending on the measuring task, supported by graphics. Includes a comprehensive knowledge database and calculation tools: ▪ For temperature competence ▪ Quick and easy design and sizing of temperature measuring points ▪ Ideal measuring point design and sizing to suit the processes and needs of a wide range of industries The Konfigurator is available: On request from your Endress+Hauser sales office on a CD-ROM for local PC installation.
W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records. W@M is available: ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00059S

System components

Accessories	Description
Field display unit RIA16	The display unit records the analog measuring signal from the head transmitter and shows this on the display. The LC display shows the current measured value in digital form and as a bar graph indicating a limit value violation. The display unit is looped into the 4 to 20 mA circuit and gets the required energy from there. For details, see the "Technical Information" document TI00144R/09/en
RN221N	Active barrier with power supply for safe separation of 4-20 mA standard signal circuits. Offers bidirectional HART transmission. For details, see "Technical Information" TI00073R and Operating Instructions BA00202R
RNS221	Supply unit for powering two 2-wire measuring devices solely in the non-Ex area. Bidirectional communication is possible via the HART communication jacks. For details, see "Technical Information" TI00081R and Brief Operating Instructions KA00110R

Documentation

Technical Information
- iTEMP temperature head transmitter:
  - TMT180, PC-programmable, single-channel, Pt100 (TI088R/09/en)
  - TMT181, PC-programmable, single-channel, RTD, TC, Ω, mV (TI00070R/09/en)
  - HART® TMT182, single-channel, RTD, TC, Ω, mV (TI078R/09/en)
  - HART® TMT82, two-channel, RTD, TC, Ω, mV (TI01010T/09/en)
  - PROFIBUS® PA TMT84, two-channel, RTD, TC, Ω, mV (TI138R/09/en)
  - FOUNDATION Fieldbus™ TMT85, two-channel, RTD, TC, Ω, mV (TI134R/09/en)
- Insert: Resistance thermometer iTHERM TS111 (TI01014T/09/en)

Supplementary documentation ATEX/IECEx:
- Intrinsically safe Ex ia IIC (XA01024T/09/a3)
- Dust-explosion protection Ex ta/tb (XA01023T/09/a3)

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